SCIENCE ABSTRACTS.

Section A.—PHYSICS.

JANUARY, 1930.

GENERAL PHYSICS.

1. Standardisation of a 25m. Jåderin Wire in Terms of the Wave-Length of the Cadmium Red Line. N. Watanabe and M. Imaizumi. *Imp. Acad. Tokyo, Proc.* **5.** *pp.* **223–226,** *June,* **1929.**

The authors developed a method of Fabry and Perot to measure the wave-length of a long standard using Brewster's white fringe and removing extraneous rays. Standardisation was made first for a 6·25 cm. standard and then extended to 1, 5 and 25 m. standards and to the Jåderin wire. It is concluded that the method may be extended without much difficulty to a length of a few hundred metres. Any small variation in length can be traced from time to time by observing the positions of the white fringe in a compensator. The method may find an application in tracing the deformation of the earth's crust, and in problems of a similar nature.

R. S. R.

2. X-Ray Studies of Particle Size in Silica. R. H. Aborn and R. L. Davidson. *Frank. Inst., J.* **208.** *pp.* **59–71,** *July,* **1929.**

The powdered silica (99·75 % SiO_2) was passed through a 325-mesh screen and further graded by the method of Hatch and Choate [see Abstract 2046 (1929)] and submitted to the unfiltered radiation from the molybdenum target of a Coolidge tube. The radiograms of the rings obtained and of microphotometric curves produced from these with the aid of the Harrison densitometer [see Abstract 2683 (1925)] are reproduced. The specimens ranged from 1·73 to 360 μ. Size distribution plays an important part in the radiograms. The diffraction pattern changes with both particle size and distribution, and a quantitative relation between pattern and average particle size can only be noted when the size distribution is approximately constant.

H. B.

3. "Limited Density" of Matter and of Energy. W. Anderson. *Zeits. f. Physik,* **56. 11–12.** *pp.* **851–856, 1929.**

Stoner's theory [see Abstract 1488 (1929)] is criticised. The compressibility of electrons and protons is considered; extreme pressure will level everything; but we cannot say how great a pressure would be required.

A. D.

4. Densities of Liquid Potassium and Sodium. E. Rinck. *Comptes Rendus,* **189.** *pp.* **39–41,** *July* **1, 1929.**

The densities of K and Na were measured by the hydrostatic method at temperatures from fusion up to as near the boiling point as possible.

The temperatures were measured by a sensitive thermoelectric arrangement. The results obtained were: Density of Na = 0·9835 − 0·000260 (t − 96·5). Density of K = 0·826 − 0·000222 (t − 62·4) between fusion and 650° C. J. J. S.

5. Densities of Co-Existing Liquid and Gaseous Nitrous Oxide. E. L. Quinn and G. Wernimont. *Am. Chem. Soc., J.* 51. *pp.* 2002–2008, *July,* 1929.

This paper describes a method of determining the densities of liquid nitrous oxide and its saturated vapour, the results recorded being for a temperature range of 30° to − 50° C. These data were found necessary in surface tension calculations. The critical density is found to be 0·459 and the molecular volume at absolute zero 28·1 c.c., adopting Sugden's equation. J. K.

6. Vacuum Contraction of Density Bulbs. M. Beckers. *Am. Chem. Soc., J.* 51. *pp.* 2042–2051, *July,* 1929.

The contraction of density globes on evacuation has been investigated in connection with examination of easily liquefied saturated hydrocarbons. A hydrostatic method of measurement has been applied to the problem, as well as the method of Travers, the results by both methods being in good agreement. The empirical equation proposed by Moles and Miravalles for the calculation of the compressibility of density globes is given additional confirmation by the results of the measurements. Data have been obtained which lend support to the hypothesis that the contraction of density globes is a linear function of the pressure difference to which the bulb is submitted. H. H. Ho.

7. Suction-Velocity of a Rotating Oil Pump. M. Czerny and H. Murmann. *Phys. Zeits.* 30. *pp.* 462–463, *July* 15, 1929.

The suction velocity of a rotating oil pump with respect to the pressure is measured directly by an experimental device herein described, and the results are plotted on a diagram. H. H. Ho.

8. Compressibility at Pressures above 50 Atmospheres of Carbon Monoxide at 0° C. S. Goig. *Comptes Rendus,* 189. *pp.* 246–248, *July* 29, 1929.

The compressibility of carbon monoxide at 0° C. has been determined at 36 different pressures ranging from 53·58 to 127·67 atmospheres, a precisely similar piezometer containing hydrogen serving as a manometer. Specimen results are:

p	53·58	66·00	70·39	83·35	93·05	110·68	127·67
pv	0·9754	0·9727	0·9717	0·9703	0·9702	0·9721	0·9760

The figures are considered correct to 0·02 %. The compressibility is, therefore, normal, corresponding figures for nitrogen for pv are, as is to be expected, slightly higher with a minimum at 78 atmospheres as against 90 atmospheres for carbon monoxide. There is no indication of any polymerisation under great pressure. C. A. S.

9. Diffusion of Gases Through Metals. V. Lombard. *Rev. de Mét.* 26. *pp.* 343–350, *July,* 1929.

A series of measurements of the diffusion of hydrogen through iron, nickel and platinum was made. Discs of the metals were clamped between mild steel blocks, and the whole was heated in an electric furnace to temperatures ranging from 300° to 1200° C. The effects of pressure, temperature and thickness of the metals upon the rate of diffusion were determined. Curves showing the results of the various factors which were investigated are included in the paper. F. J. B.

10. Measurement of Relative Viscosity of Gases. A. Weissweiler. *Phys. Zeits.* 30. *pp.* 364–367, *June* 1, 1929.

A quartz fibre is suspended by one end in a tube through which the gas streams and its deflection is observed. If two gases are of equal density the deflections are as the squares of the viscosity. If they have equal viscosity the deflections are inversely as the densities. From these two rules the viscosity of any gas can be compared with the viscosity of another gas. E. E. F. d'A.

11. Change of Surface Tension of Gelatin with *p*H, and with Small Concentrations of Electrolytes. N. Jermolenko. *Kolloid Zeits.* 48. *pp.* 141–146, *June*, 1929.

The surface tension of a 0·1 % gelatin sol showed a minimum in the isoelectrical point when the *p*H value was 4·7, and two maxima at *p*H = 2·85 and 8·3. The surface tension was measured by rise of liquid in a capillary tube. The surface tension was found to fall at acid concentrations of 10^{-5} to 10^{-14}, at still lower concentrations (10^{-14} to 10^{-17}) it was equal to the isoelectrical point. The minimum limiting concentration of an electrolyte, which could bring about a change in the properties of a reversible colloid, was 10^{-13} to 10^{-14} normal. F. J. B.

12. Development of Velocity Distribution for Turbulent Flow. L. Schiller and H. Kirsten. *Zeits. f. techn. Physik,* 10. 7. *pp.* 268–274, 1929.

After a brief discussion of the importance of obtaining exact values, the authors give a number of curves which show the development of the velocity distribution, for various flow lengths, across the tube diameter for turbulent flow, the true end profile being obtained from 50 to 100 measurements across the tube. The curves also give a comparison between rounded and sharp entry tubes. From the end profile it is found that the ratio of the average velocity across the tube to the maximum velocity is 0·80. With an entry which does not produce any disturbance in the flow, laminar streaming is chiefly obtained, the velocity distribution of which is in good agreement with Schiller's laminar flow theory. With Reynolds numbers from 10,000 to 50,000 for the end conditions, the velocity is found to be proportional to the 1/7th power of the distance between walls. R. C. F.

13. Hollow Space Formation in the Ideal Fluid. C. Schmieden. *Ann. d. Physik,* 2. 3. *pp.* 350–356, *July* 15, 1929.

Ramsauer and Dobke showed that a hollow space is formed in the wake of spheres moving rapidly through water [see Abstract 796 (1928)]. The present author considers this hollow space formation in an ideal fluid, and deals with the general properties of the strata possessing unsteady flow. The possibilities of the origin of this unsteady flow are also examined. The conclusions obtained are then used to solve the problem of the limits of the space formation for a cylinder moving in the fluid. R. C. F.

14. Transport of Sediments by Streams. H. Jeffreys. *Cambridge Phil. Soc., Proc.* 25. *pp.* 272–276, *July*, 1929.

When a solid rests on the bed of a stream, the points of contact are points of zero velocity, while the velocity just above the solid must be greater than the general. The existence of pressure effects which may be sufficient to raise the solid is thus evident. By carrying out the formal solution for a cylinder, the order of magnitude of the effect is found. This agrees with the observed, although the calculated critical velocity is less, as several additional considerations would make us expect. W. G. B.

15. Variation of the Horizontal Wind Components in Turbulent Air Currents. H. Ertel. *Gerlands Beitr. z. Geophys.* 23. 1. *pp.* 15–21, 1929.

Following upon the Hesselberg-Björkdal law of distribution of wind disturbance the law of direction distribution of the horizontal velocity components in turbulent wind is deduced, and an expression for the mean variation of direction is obtained. The latter is found to be directly proportional to the square root of the turbulence energy and inversely proportional to the square root of the energy of smooth motion. J. J. S.

16. Elastic Suspension of Pendulums. J. Haag. *Comptes Rendus*, 188. *pp.* 1479–1481, *June* 3, 1929.

On former theories the wire is assumed to be in the form of a circular arc, but this is often incorrect. A theory of the movement is given making no such assumptions, and equations are established for the two periods of oscillation. To get a strict sinusoidal oscillation the applied force must act at the centre of gravity. R. S. R.

17. Extension of Phillips' Conditions Concerning the Spiral. J. Haag. *Comptes Rendus*, 189. *pp.* 86–88, *July* 8, 1929.

The spiral giving perfect isochronism should satisfy Keelhoff's conditions. No curve exists which can exactly fulfil these conditions, and the present author develops the approximate solutions, considering the cases of the cylindrical and flat spirals. For the cylindrical spiral, Phillips' conditions are satisfied by one particular solution of the general equation, whilst Keelhoff's conditions are rigorously verified over a comparatively large range. Considering the first order approximation, the flat spiral satisfies Phillips' conditions, and as this is also the limiting state, the conditions enumerated by Phillips completely solve the case of the flat spiral. [See also next Abstract.] R. C. F.

18. Extension of the Résal-Caspari Method of Calculating the Deformation of a Spiral. J. Haag. *Comptes Rendus*, 189. *pp.* 142–144, *July* 22, 1929.

Résal calculated directly the deformation of the cylindrical spiral from the elastic theory, whilst Caspari derived approximate formulæ from certain assumptions. The present author shows how the same method of approximation can be applied to obtain the deformation of any spiral whatsoever. Further, the calculations necessary are more easily performed than those of the other authors mentioned. Finally, priority of some previous work published by the author is shown to be due to Tricomi, although the work was performed at the same time. [See also preceding Abstract.] R. C. F.

19. Interferometer Method for Investigating the Form of Steel Balls and for Testing the Hertz Pressure Equations. O. Schönrock and E. Einsporn. *Zeits. f. Instrumentenk.* 49. *pp.* 317–331, *July, and pp.* 369–385, *Aug.*, 1929. *From the Reichsanstalt.*

The investigation was carried out with the large Schönrock interference apparatus of the Reichsanstalt, a description of which is published for the first time. The Haidinger interference rings, produced in the air space between two very good plane quartz plates, separated by three steel balls of nearly equal diameter, were observed. The balls were placed at the corners of an equilateral triangle, and two of them were regarded as standards, while the third was measured along a number of different diameters. The theory of the relation between the alteration in the radius of an interference ring and the change in diameter of the ball measured is worked out in detail. The effect of the pressure of the plates is dealt with theoretically and experimentally, making use of the Hertz equations; good agreement was obtained. The effects of temperature and atmospheric pressure were also investigated. H. N. A.

20. New Optical Method for Determination of Internal Tension. H. Favre. *Rev. d'Optique*, 8. *pp.* 193–213, *May;* 241–261, *June–July, and pp.* 289–307, *Aug.*, 1929.

Experimental determination of interior tensions at any point of a test-piece is considered. In plane elasticity this depends on (1) the angle α which one of the two principal tensions makes with a fixed direction and (2) the values σ_1 and σ_2 of these tensions. α is found by placing the test-piece between two crossed nicols. A polarised ray traversing the test-piece at null incidence gives two polarised rays on emergence, and the measurement of the difference in phase of these two rays permits by means of Wertheim's law of obtaining a first relationship between σ_1 and σ_2. The author now shows how it is possible by measuring the variations of absolute phase of the two emergent rays to obtain two new relationships between σ_1 and σ_2, which, in conjunction with Wertheim's law, not only enable the calculation of σ_1 and σ_2 at any point of the test-piece but also the average errors of the results obtained. A description is given of the laboratory of photoelasticity at Zürich Polytechnic, and of the Mach-Zehnder interferometer in use. A comparison is given between data from the purely optical method and from the general theory of elasticity. H. H. Ho.

21. Remarks on Crystal Plasticity. W. Boas and E. Schmid. *Zeits. f. Physik*, 56. 7–8. *pp.* 516–523, 1929.

Constancy of shearing stress in translation systems is in the cases so far studied of plastic crystal deformation quantitatively equivalent to constant elastic shear. A discussion is given of the flow conditions of v. Mises [see Abstract 2910 (1928)]. Constancy of the normal tension across the split face is not equivalent to constant normal dilation. J. E.

22. Flow Phenomena in Plastic Materials. W. Braunbek. *Zeits. f. Physik*, 57. 7–8. *pp.* 501–532, 1929.

Experiments upon the flow of a very viscous substance (Chatterton compound) were made at different temperatures, with a view to finding how the limiting speed depended upon the stress and the viscosity. The substance was contained in a long tube, and a torque applied to a coaxial cylinder. On applying the torque, a sudden (elastic) deformation occurred, and then rotation commenced, the speed decreasing to a limit. On removing the torque, an elastic deformation of equal amount in the reverse direction occurred, followed by a rotation whose speed decreased asymptotically to zero. The velocity curves for these two cases were identical in form and magnitude. At high temperatures (100°–140° C.) the limiting speed was a linear function of the stress, but at lower temperatures (50°–60°) the relation is not linear. The limiting velocity depends upon the temperature being proportional to $e^{A/T}$ (A a const., T = temp.). The velocity approached its limiting value more slowly than any exponential. For small stresses, Prandtl's theory is verified. W. G. B.

23. Cohesion Relationships in Certain Artificial Crystals and Significance of Gliding Planes for Certain Changes of State. O. Mügge. *Zeits. f. Krist.* 71. 1–2. *pp.* 64–80, *July*, 1929.

A complete description is given of the following synthetic crystalline products: diammine zinc chloride, amido-guanidine nitrate, and the butyrates of calcium, strontium and barium, and a discussion is included of their behaviour towards torsion and the significance of their planes of slip with respect to changes of state. H. H. Ho.

24. Energy Equation for Calculation of Resistance and Velocity of Stones Falling in Water. F. M. Exner. *Phys. Zeits.* 30. *pp.* 458–462, *July* 15, 1929.

This paper continues previous work on air bubbles in water [see Abstract 525 (1928)]. A simple energy equation is derived, which obviates the consideration of empirical coefficients of friction, whereby the velocities of symmetrical solid bodies falling through water may be calculated. Deviations from the older hydrodynamic theory are discussed, and, finally, the limiting cases of very fine sand particles are considered. Comprehensive tables of experimental data are included in support of the theory.
H. H. Ho.

25. Design for Drawing Curves. P. G. Nutting. *J.O.S.A. and R.S.I.* 19. *pp.* 29–32, *July*, 1929.

Drawing curves obtainable commercially are intended to apply chiefly to ship ribs or to machine parts, and are not always suitable for physical, chemical or statistical work. Makes suggestions as to the sizes of new curves which would be required. The rational theory of design must deal with the intrinsic equations of the curves to be represented; the three requisite data are maximum curvature, range in curvature and law of variation in curvature for each particular curve. Describes a device for drawing intrinsic curves of different kinds to serve as master curves. A toy automobile is fitted with a tiller steering gear and a drawing point. A simple curve may be cut from sheet material and wrapped round the rear axle as a guide to the tiller to obtain different master curves.
H. N. A.

26. Error Tensors, Error Affines and General Error Distribution Laws. A. Basch. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 3–4. *pp.* 125–168, 1929.

The application of tensor analysis to the discussion of observational errors and distribution laws [see Abstract 1069 (1929)] is extended to functions of many vectors and scalars. J. S. G. T.

27. Fourier Transform Theorem. A. C. Berry. *J. Math. Phys., Mass. Inst. of Technology*, 8. *pp.* 106–118, *July*, 1929.

28. Solids Referred to Which a Material System Is Only Subject to Internal Forces. C. Platrier. *Comptes Rendus,* 189. *pp.* 23–24, *July* 1, 1929.

Proves that, referred to any set of axes connected rigidly to such a solid, the " energy of acceleration " is constantly a minimum. [See also Abstract 1759 (1929).] W. G. B.

29. Equimomental Systems. P. Franklin. *J. Math. Phys., Mass. Inst. of Technology,* 8. *pp.* 129–140, *July,* 1929.

Rigid systems of mass points, which have the same moment of inertia about every axis in space, are said to be equimomental. Introduces the elementary equimomental operation of " sliding " to pass from one system to an equimomental one; the system of two points, P_1 with mass m_1 and P_2 with mass m_2, distant respectively km_2 and km_1 from their centre of gravity, can be replaced, by an operation of sliding, by a second pair of points on the same straight line, equimomental to the first pair; if m'_1 and m'_2 are their masses and $k'm'_2$, $k'm'_1$ their respective distances from the same centre of gravity, then $m_1+m_2=m'_1+m'_2$ and $k^2m_1m_2=k'^2m'_1m'_2$. The first theorem proved is " For any finite set of mass-points in a plane an equimomental set of three mass-points may be found by slidings." Thirteen other theorems and a number of corollaries are stated dealing with the subject; and the paper concludes with some illustrations of their use. H. N. A.

30. Effect of Volume Changes on Infra-Red Vibrations of Simple Crystals. E. O. Salant. *Nat. Acad. Sci., Proc.* 15. *pp.* 533–537, *June,* 1929.

Starting from Carpenter and Stoodley's relation between the law of force between the ions in a sodium chloride type of crystal and the vibration frequency, calculation is made of the effect on frequency of change of distance apart of the ions brought about by temperature or pressure changes. Numerical calculation suggests that for KCl, KBr and KI, but not for NaCl, the temperature shifts of the reflection bands would be measurable. Herzfeld points out that if the exact theory is used instead of the Carpenter-Stoodley equation, $d\lambda_0/dV$ and $d\lambda m/dV$ would be increased by 15–20 %. W. H. GE.

31. Crystal Structure of Barium. A. J. King and G. L. Clark. *Am. Chem. Soc., J.* 51. *pp.* 1709–1710, *June,* 1929.

The crystal structure of very pure barium has been found to be body-centred cubic with a parameter of 5·015 ± 0·003 Å., and the atomic radius calculated from these data is 2·171 Å. at room-temperature. AUTHORS.

32. Crystal Structure of Binary Compounds of Platinum Metals. L. Thomassen. *Zeits. f. phys. Chem.* 4. *Abt. B.* 4. *pp.* 277–288, *July,* 1929.

Previous work on similar compounds has already been described [see Abstract 2673 (1929)]. The following compounds have a pyrites structure: $PtAs_2$, PtP_2, RhS_2. PtSb has a nickel arsenide structure. The lattice constants are given. A. A. D.

33. Crystal Structure of Covellite. H. S. Roberts and C. J. Ksanda. *Am. J. Sci.* 17. *pp.* 489–503, *June,* 1929.

In dealing with the spectrograms the artifice due to P. P. Ewald is employed, by means of which the crystallographic planes and their spacings are represented by a three-dimensional collection of points called the reciprocal lattice. The crystals are hexagonal, $a_0 = 3 \cdot 802$ Å., $c_0 = 16 \cdot 43$Å.; there are six molecules in the unit cell, space group D_{6h}^4. An arrangement of the copper and sulphur atoms is worked out which fits this space group, and offers a satisfactory explanation for the perfect basal cleavage and for the possibility of gliding parallel to the base. H. N. A.

34. Determination of Lattice Edge of Potassium Platinibromide. M. Mathieu. *Comptes Rendus*, 188. *pp.* 1611–1612, *June* 17, 1929.

The powder method shows the structure of potassium platinibromide to be identical with that of the platinichloride (face-centred cubic), and the ratios of sin θ for the various planes of the two salts constant, averaging $1 \cdot 07$. Hence a for the platinichloride being $9 \cdot 64$, a for the platinibromide is $10 \cdot 35 \pm 0 \cdot 05$. There are 4 molecules in the unit cell. C. A. S.

35. Isogonal Polyhedra and Space Group Theory. T. Ito. *Zeits. f. Krist.* 70. 5–6. *pp.* 393–459, *June*, 1929.

Mathematical. W. H. Ge.

36. Optical Representation of X-Ray Crystal Analysis Results. W. L. Bragg. *Zeits. f. Krist.* 70. 5–6. *pp.* 475–492, *June*, 1929. *In English.*

The paper describes an optical method of reproducing the results of X-ray crystal analysis. Use is made of the analogy between the principle underlying the interpretation of X-ray results, and that formulated by Abbe in treating the resolving power of the microscope. The X-ray spectra are treated as if they were optical spectra, each pair of X-ray measurements around a zone [100], such as $F(0kl)$ and $F(0\bar{k}\bar{l})$ contributing a periodic fluctuation of density to the projection on the face (100) of the crystal. A specially prepared plate is used as a source of harmonic bands of light and shade which can be projected on to a sheet of photographic paper, marked with the form of the face (100) of the crystal cell. A series of perhaps forty projections is made on to the photographic paper, with position and exposure depending on the X-ray measurements and calculation. The developed paper then shows an image of the crystal cell as projected on one of its faces, all the atoms appearing in their correct positions. By projecting on the three faces of the cell in turn, the positions of the atoms in space can be found. These "microphotographs" are reproduced for diopside, $CaMg(SiO_3)_2$. W. H. Ge.

37. Outlines of Theory of Symmetry in Lines and Planes. A. M. Günzburg. *Zeits. f. Krist.* 71, 1–2. *pp.* 81–94, *July*, 1929.

Contains an account of work done mainly in the years 1920–1923. Both straight lines and spirals are dealt with. Thirty-two figures are given to illustrate different kinds of symmetry in planes, but the actual number of cases of symmetry found was only 26. H. N. A.

38. Structure Theory of Plane Symmetry Groups. H. Heesch. *Zeits. f. Krist.* 71. 1–2. *pp.* 95–102, *July*, 1929.

Classifies the 80 symmetry groups in the plane, the two sides being considered and a system of symbols given. These groups apply to plane ornaments, carpets and ornamental low relief. The number of groups for woven articles, nets, etc., is considerably lower. A table shows the relation between the numbers assigned to the groups by the author and by Weber. H. N. A.

39. Diagram of Physical Properties of Crystals. J. Kunz. *Phys. Zeits.* 30. *pp.* 463–464, *July* 15, 1929.

A diagram is described which amplifies Born's figure by the representation of the magnetic phenomena of crystals, and this is achieved by means of a triangular prism. H. H. Ho.

40. Crystal Structure and Chemical Constitution. *Faraday Soc., Trans.* 25. *pp.* 253–366, *June, and pp.* 367–409; *Disc.*, 410–420, *July,* 1929.

A lecture on "Crystal Structure and Chemical Constitution," by **V. M. Goldschmidt,** and followed by a series of contributions as follows: Part I. Inorganic Compounds.—"Co-ordination Numbers," by **F. I. G. Rawlins**; "Electronic Theory of Valency. Part VII. Etch Figures of Sylvine," by **T. M. Lowry** and **M. A. Vernon**; "Atomic Arrangement in the Silicates," by **W. L. Bragg;** "Structure of the AX_4 Group," by **A. M. Taylor;** "Fine Structure of Felspars," by **E. Schiebold;** "Constitution and Structure of Ultramarine," by **F. M. Jaeger.** Part II. Organic Compounds.—"Introduction," by **W. H. Bragg;** "Hydrocarbon Model," by **A. Müller;** "Examples of Information Obtainable from Long Spacings of Fatty Acids," by **S. H. Piper;** "X-ray Evidence on Structure of Benzene Nucleus," by **(Mrs.) K. Lonsdale.** Part III. Metals.—"Problem of the Metallic State," by **J. D. Bernal;** "X-ray Studies on Alloys," by **A. F. Westgren** and **G. Phragmén.** Part IV. General.—"Intensity, Sharpness and Reproducibility of Debye-Scherrer Lines," by **H. Möller** and **A. Reis;** "Determination of Particle Size by Use of X-rays," by **H. Mark;** "Abnormal Broadening of Spectral Lines," by **A. W. Porter;** "Lattice Determination in Polycrystalline Aggregates," by **K. Weissenberg;** "Allotropy and Determination of Densities by Means of X-rays," by **N. H. Kolkmeijer;** "Integrating Microphotometer for X-ray Crystal Analysis," by **W. T. Astbury;** "Two-circle X-ray Spectrometer," by **W. A. Wooster;** "Modern Developments of Wave Mechanics and their Bearing on Crystal Structure," by **P. P. Ewald.**

41. Examination of Ice-Crystals by X-Rays. U. Yoshida and S. Tsuboi. *Kyoto Coll. Sci., Mem.* 12. *pp.* 203–207, *July,* 1929. *In English.*

The orientation of ice-crystals obtained under various conditions was examined by means of X-rays, and it was found that all directions parallel to the basal plane of the hexagonal crystal of ice are equally suited for its growth. AUTHORS.

42. Röntgen Diagram of Mercerised Cellulose. K. R. Andress. *Zeits. f. phys. Chem.* 4. *Abt. B.* 3. *pp.* 190–206, *July,* 1929.

This paper is a continuation of previous work on the Röntgen diagram of native cellulose [see Abstract 2927 (1929)]. The Röntgen diagram of mercerised cellulose may be satisfactorily explained on the basis of a monoclinic element having the following measurements: $a = 8 \cdot 1$ Å., $b = 10 \cdot 3$ Å., $c = 9 \cdot 1$ Å., $\beta = 62°$. The interference intensities of the diagram were very well explained on the basis of a structure of glucose residues united in a cellobiose manner. The atomic arrangement within the hexoses is almost the same as that of native cellulose. The difference between mercerised and native cellulose arises in a different arrangement of neighbouring chief valency chains to each other. The mercerised lattice is regarded as the stable state. H. H. Ho.

43. Translation Lattice of Methylcellulose. X-Ray Studies of Cellulose Derivates. C. Trogus and K. Hess. *Zeits. f. phys. Chem.* 4. *Abt. B.* 5. *pp.* 321–345, *Aug.*, 1929.

The interference diagrams obtained from fibrous trimethylcellulose are discussed on the assumption of a unit elementary rhombic cell of dimensions $a = 21 \cdot 3$ Å., $b = 25 \cdot 6$ Å., $c = 11 \cdot 3$ Å. The discussion is extended to the constitution of cellulose and cellulose hydrate. F. J. W.

44. Structure of Tetramethyl Ammonium-Perchlorate and -Permanganate. K. Herrmann and W. Ilge. *Zeits. f. Krist.* 71. 1–2. *pp.* 47–63, *July*, 1929.

From X-ray rotation and Laue photographs it is deduced that the unit tetragonal cells contain two molecules of $(CH_3)_4N-ClO_4$ or $-MnO_4$. Space Group D_{4h}^7. Dimensions: $a = 8 \cdot 290$, $8 \cdot 439$; $c = 6 \cdot 006$, $6 \cdot 019$ Å., respectively. The lattice is ionic and the two ions $N(CH_3)_4$ and ClO_4 (or MnO_4) have tetragonal bisphenoidal symmetry. W. H. Ge.

45. Crystal Structure of Staurolite. S. Náray-Szabó. *Zeits. f. Krist.* 71. 1–2. *pp.* 103–116, *July*, 1929.

Staurolite is orthorhombic holohedral. Its space group was found to be V_h^{17} by Cardoso. This classification has been checked by the author and the structure fully determined. It is based on the cubic close-packed oxygen arrangement; the orthorhombic unit cell has the edges $a = 7 \cdot 82$ Å., $b = 16 \cdot 52$ Å., $c = 5 \cdot 63$ Å., and contains four molecules of $H_2FeAl_4Si_2O_{12}$. The arrangement of atoms shows that staurolite is a compound of $Fe(OH)_2$ and $2Al_2SiO_5$ (cyanite). Explanations of the variable composition and of the twinning effects are given. J. E.

46. Crystal Structure of Cyanite. S. Náray-Szabó, W. H. Taylor and W. W. Jackson. *Zeits. f. Krist.* 71. 1–2. *pp.* 117–130, *July*, 1929.

Cyanite is the triclinic form of Al_2SiO_5. A complete structure has already been suggested by two of the authors [see Abstract 2065 (1928)], which is found to be not quite correct. A new structure is here suggested, based on the structure of staurolite [see preceding Abstract], which was found to consist of alternate slabs of $Fe(OH)_2$ and Al_2SiO_5. The structure of the slabs of Al_2SiO_5 in staurolite satisfies the analysis of cyanite obtained by the present authors from rotating crystal photographs. J. E.

47. X-Ray Investigation of Structure of Zinc Silicate. A. Pabst. *Zeits. f. phys. Chem.* 142. *Abt. A.* 3. *pp.* 227–232, *July*, 1929.

Zinc silicate has been made by heating a compressed mixture of SiO_2 and ZnO at 800° C. for several days. The metasilicate could not be formed even with stronger and longer heating. The structure of the orthosilicate was the same as willemite. J. E.

48. Crystal Structure of Thorium Boride. G. Allard. *Comptes Rendus*, 189. *pp.* 108–109, *July* 8, 1929.

Using $CuK\alpha$ X-rays and the powder method it is deduced that ThB_6 is cubic with one molecule in a unit cell of edge $4 \cdot 32$ Å. Density $6 \cdot 27$. The boron atoms are arranged octahedrally round the thorium atom.
W. H. Ge.

49. Crystal Structure of Picric Acid. M. A. Bredig and H. Möller. *Zeits. f. Krist.* 71. 4. *pp.* 331–343, 1929.

The space group appears to be C_{2h}^5. The structure is unsymmetrical,

the units being two molecules, polarised and forming an associated pair. The habit follows easily from the suggested space group symmetry.
J. E.

50. X-Ray Studies of Nitrides of Manganese. G. Hägg. *Zeits. f. phys. Chem.* 4. *Abt. B.* 5. *pp.* 346–370, *Aug.*, 1929.

Manganese nitrides have been prepared by heating the metal in either nitrogen or ammonia. Four nitride phases were found. That containing the least nitrogen (about 2 %) is stable only over 500°. The manganese atoms are arranged in a face-centred tetragonal lattice: $a = 3 \cdot 765$ Å., $c = 3 \cdot 684$ Å. At about 400° a phase containing 6–6·5 % nitrogen is stable. The metal atoms are arranged on a face-centred cubic lattice. At slightly lower temperatures this passes into a hexagonal close-packed lattice. The nitrogen content is between 9·5 % and 11·9 %. The last two phases find analogues in the Fe — N system. A phase yet richer in nitrogen (13·5 %) has been obtained having a face-centred tetragonal lattice.
F. J. W.

51. Problem in Brownian Motion. G. E. Uhlenbeck and S. Goudsmit. *Phys. Rev.* 34. *pp.* 145–151, *July* 1, 1929.

Deals mathematically with Gerlach's investigation of the rotational Brownian motion of a small mirror suspended on a fine wire. If the displacement during a time, long compared with the characteristic period of the mirror, is developed into a Fourier series, the square of the amplitude of each Fourier component is found to be a function of the pressure and molecular weight of the surrounding gas, as well as of its temperature. The sum of the squares is a function of the temperature alone. Obtains an expression for the fluctuating torque on the mirror due to the bombardment of the gas molecules.
H. N. A.

52. Molecular Volumes at Absolute Zero. Part III. Zero Volumes, Parachors and Molecular Diameters. S. Sugden. *Chem. Soc., J. pp.* 1055–1058, *June*, 1929.

This paper continues previous work [see Abstract 2 (1928)] and discusses Biltz's results (*Nachr. Ges. Wiss. Göttingen*, 1926, 45; *Annalen der Chemie*, 1927, 453. 259) for zero volumes and for the atomic and structural constants alongside those of the author. Since fairly close agreement occurs, an examination is made of the relationship between zero volumes (and, in addition, parachors and critical volumes) and the actual dimensions of the molecules. Since molecular volumes have to be compared with the viscosity data, the molecules are treated as spheres, although uncertainty is introduced into the values for more complex molecules. It appears evident that, by comparing molecular volumes at equal surface tensions, the effect of the intermolecular field is largely eliminated, and a closer parallelism with the dimensions of molecules calculated from gas viscosities is obtained.
H. H. Ho.

53. Mesophases (Intermediate States of Aggregation). Parts II and III. H. Zocher and V. Birstein. *Zeits. f. phys. Chem.* 142. *Abt. A.* 2. *pp.* 113–138, *June*, 1929.

Part II deals with the mutual arrangement of the volume elements of a mesophase. The parallel or perpendicular arrangement of the axis to the boundary layer in the nematic as in the smectic state is caused by differences of surface tension at the boundary layer. It is shown that the surface of ordinary glass may be so altered by acid treatment that in the case of *p*-azoxyanisole perpendicular instead of parallel orientation occurs, whereas alkaline treatment reverses the change. The elastic deformability of mesophases is much greater than that of crystals in circumstances which call forth neither compression nor dilatation resistance. In closed metastable configurations the axial lines are given by the formula $r = \left(a \sin \frac{n-2}{2} \alpha\right)^{\frac{2}{n-2}}$ (r and α being polar coordinates and n an integer), on the assumption of uniform change of direction. Microscopic photographs of *p*-azoxyphenetole are included to show the course of the axial lines. Real points of instability exist in both states of aggregation. The aqueous mesophase of salvarsan is discussed. In the amorphous solution the smallest suspended drops are built up of optically negative volume elements of microscopic dimensions, and by addition of optically active substances the same drilled structure is produced in the salvarsan mesophase as is known in various other nematic phases. [See also Abstract 2941 (1929) and next Abstract.] H. H. Ho.

54. Mesophases (Intermediate States of Aggregation). Parts IV and V. H. Zocher and V. Birstein. *Zeits. f. phys. Chem.* 142. *Abt. A.* 3. *pp.* 177–194, *July*, 1929.

Part IV deals with further cases of aqueous mesophases. It is found that mesophases only definitely occur among the soaps with the oleates of potassium and sodium, the stearates and palmitates separating from aqueous solutions in crystalline condition. The mesophases concerned are smectic, and sodium naphthenate usually affords a smectic mesophase in aqueous solution. The nematic phase, which bromophenanthrene-sulphonic acid forms in aqueous solutions of ordinary concentration, shows unusual negative double refraction and forms drops with optically positive radii. The diffuse double refraction observed in many cases is ascribed to anisotropic colloidal particles. Dielectric anisotropy appears to be negative in all the cases investigated even when it is positive for the corresponding nematic phase. Magnetic anisotropy appears to be always positive. [See also preceding Abstract.] H. H. Ho.

55. Quantity Allowing of New Classification of Atoms. G. Fournier. *Comptes Rendus*, 188. *pp.* 1553–1555, *June* 10, 1929.

As neither atomic weight (A) nor atomic number (N) alone is sufficient to define an atom completely, it is proposed to do so by the "filiation capacity," U = 3A/4–N, which decreases by unity on either an α- or β-ray emission, and which is the sum of the α- and β-transformation capacities (A/4 and A/2–N respectively). Save for atoms arising from the same atom by bifurcation of the radioactive line of descent, the value of U is, with rare exceptions (*e.g.*, krypton, N = 36, A = 78, and zinc, N = 30, A = 70), sufficient completely to define an atom. C. A. S.

56. Nucleus as Radiator. W. M. Hicks. *Phil. Mag.* 8. *pp.* 108–114, *July*, 1929.

A theory is put forward in which the nucleus of the atom is the essential origin of radiations. The electron, the atom and the nucleus are considered from this point of view. The electromagnetic theory of light is assumed to be real, and atoms are assumed to be configurations of matter which obey the laws of dynamics and electromagnetism. F. J. B.

57. Radii and Collision Probabilities of Metastable Neon and Mercury Atoms. M. W. Zemansky. *Phys. Rev.* 34. *pp.* 213–226, *July* 15, 1929.

The problem of the life-time of metastable atoms was treated on the basis of the assumptions that (1) metastable atoms diffuse to the walls of the containing vessel and give up their energy there, and (2) metastable atoms perform impacts with other atoms and are either lowered to the normal state or raised to a higher state. The result was obtained that, for large values of the time elapsing after the cut-off of the excitation, the average number of metastable atoms per cc. decays exponentially with the time, with an exponential constant equal to $A/p + Bp$, where p is the pressure and A and B are constants containing the radius of the metastable atom and the probability of dissipative impact. The experimental results of Meissner and Graffunder, Eckstein, Zemansky and Pool are treated according to the theory, and values of the radius and probability are found. The radius in each case comes out smaller than the normal value, and the values of the probability are shown to substantiate the view that, in impacts between metastable atoms and either normal atoms of the same kind or foreign gas atoms whose first excitation potential is higher than the energy of the metastable atom, the metastable atom is raised to a state of higher energy. AUTHOR.

58. New Features of Atmospheric Oxygen Bands and Relative Abundance of the Isotopes O_{16}, O_{18}. H. D. Babcock. *Nat. Acad. Sci., Proc.* 15. *pp.* 471–477, *June*, 1929.

Accurate values of certain constants associated with the atmospheric oxygen bands and with the oxygen molecule have been given in a preceding paper [see Abstract 348 (1928)], when a new band, A′, was also described. This band has been shown by other authors to correspond to one which would be expected if oxygen consists of two isotopes of mass 16 and 18 respectively. Aston has stated that if O_{18} exists its proportion can hardly exceed 1/1000 of O_{16}. The present author gives further data confirming the existence of O_{18}, and from the experimental results obtained the proportion of O_{18} to O_{16} is found to agree with Aston's conclusion, O_{18} being 1/1250 of O_{16}. Other new features of the band spectrum of oxygen are also described, one of which indicates the existence in the ordinary molecule of something equivalent to a minute dissymmetry. R. C. F.

59. Angular Momentum and Diamagnetism of the Normal Hydrogen Molecule. J. H. van Vleck and Amelia Frank. *Nat. Acad. Sci., Proc.* 15. *pp.* 539–544, *July*, 1929.

Shows that the mean square angular momentum is somewhat less than half the square of the Bohr unit. The calculated molar susceptibility of hydrogen is $-4{\cdot}20 \times 10^{-6}$. E. E. F. d'A.

60. Molecular Binding and Low ^5S Terms of N^+ and C. L. A. Turner. *Nat. Acad. Sci., Proc.* 15. *pp.* 526–528, *June*, 1929.

Herzberg's analysis of the negative bands of nitrogen suggested that the dissociation of the excited molecular ion produces a normal atom and a normal atomic ion, whereas the dissociation of the normal molecular ion produces an atom and an ion, one of which is excited. From measurements of energy difference the assumption is made that the normal molecular ion dissociates into a normal ion and an excited atom. Heitler and Herzberg have recently shown in the case of CN and SiN that the energy differences cannot be attributed to energy of excitation of a N atom. They suggest that the excited state of N^+, C and Si is the $2s(2p)^3\,{}^5S$ state. The correct fixation of these ${}^5S$ terms is of importance because it will give support for London and Heitler's theory of the quadrivalence of these atoms if they are found to be very low. The results with N^+ indicate that this is the case. T. B.

61. Problem of Ionised Hydrogen Molecule. C. Y. Chao. *Nat. Acad. Sci., Proc.* 15. *pp.* 558–565, *July,* 1929.

It is shown that the problem belongs to the group of problems in which the polynomial method of wave mechanics, introduced by Brillouin and Wentzel and developed by Sommerfeld, gives the same result as the old quantum theory in approximation (0) and half-quantum numbers in approximation (1). The problem is worked out mathematically to approximation (2), and a graph is obtained showing the relation between E^*/E_H and ρ for values of ρ between 1·372 and 2·952. This agrees closely with Burrau's result, with the minimum at $\rho = 2{\cdot}08$, $E^*/E_H = 1{\cdot}201$, or 0·04 volt higher than Burrau's value. The present result agrees with the experimental value within the limits of error; this may be fortuitous. In connection with half-quantum numbers considers the adiabatic transition in the gradual separation of the two nuclei; arrives at an equation which gives the adiabatic transition of the energy levels when H_2^+ is dissociated into a nucleus and an H-atom. H. N. A.

62. Diatomic Molecules According to Wave Mechanics. Part I. Electronic Levels of the Hydrogen Molecular Ion. P. M. Morse and E. C. G. Stueckelberg. *Phys. Rev.* 33. *pp.* 932–947, *June,* 1929.

The H ion is the simplest form of molecule, consisting of two nuclei and a common electron. The sum of the electronic potential and kinetic energies is approximately independent of the rotatory or vibrational velocity of the nuclei, and depends on their instantaneous relative separation. The energies are calculated by wave mechanics as functions of the nuclear separation, $c = 2\rho$, for several values of the quantum numbers. Elliptical coordinates are employed, and the number of nodal surfaces in any one of the three coordinates is equal to the quantum number in that coordinate. The relation between the quantum numbers is traced as ρ changes from zero to infinity. The electronic energies plus the energy of nuclear repulsion give the molecular potential energies. A calculation of these shows that of the eight curves obtained only three, the $1s\sigma$, $3d\sigma$ and $4f\sigma$ states, show minima; these are, therefore, stable configurations to the order of approximation employed. The numerical results agree with previous calculations and with the data available. [See next Abstract.]
H.N.A.

63. Diatomic Molecules according to Wave Mechanics. Part II. Vibrational Levels. P. M. Morse. *Phys. Rev.* 34. *pp.* 57–64, *July* 1, 1929.

An exact solution is obtained for the Schrödinger equation representing the motions of the nuclei in a diatomic molecule, when the potential energy function is assumed to be of a form similar to those required by Heitler and London and others. The allowed vibrational energy levels are found to be given by the formula $E(n) = E_e + h\omega_0(n + 1/2) - h\omega_0 x(n + 1/2)^2$, which is known to express the experimental values quite accurately. The empirical law relating the normal molecular separation r_0 and the classical vibration frequency ω_0 is shown to be $r_0^3\omega_0 = K$ to within a probable error of 4 %, where K is the same constant for all diatomic molecules and for all electronic levels. By means of this law, and by means of the solution above, the experimental data for many of the electronic levels of various molecules are analysed, and a table of constants is obtained from which the potential energy curves can be plotted. The changes in the above-mentioned vibrational levels due to molecular rotation are found to agree with the Kratzer formula to the first approximation. [See preceding Abstract.] AUTHOR.

64. Momentum Distribution in Hydrogen-Like Atoms. B. Podolsky and L. Pauling. *Phys. Rev.* 34. *pp.* 109–116, *July* 1, 1929.

A mathematical derivation is given of the momentum eigen functions γ_{nlm} (P, Θ, Φ) for the electron in the hydrogen atom problem, where P, Θ, Φ are polar coordinates of the total momentum vector referred to the same axes as the coordinates r, θ, ϕ, of the electron. These quantities γ play an analogous part for the electron momentum to that played by $\Phi_{nlm}(r, \theta, \phi)$ the Schrödinger eigen functions for the electron position, *i.e.*, the probability that the electron momentum will lie in a certain volume element dV of the momentum space is given by $|\gamma_{nlm}(P, \Theta, \Phi)|^2 dV$. The probability that the total electron momentum will have a certain absolute value (irrespective of its direction) is also worked out. The average value of the square of the momentum for all states having the same principal quantum number n is found to be the same in the present wave theory treatment, as in the Bohr orbit or older quantum theory. W. S. S.

65. Motion of a Particle as a Statistical Problem and Bohr-Heisenberg's Uncertainty Conditions. D. Meksyn. *Phil. Mag.* 7. *pp.* 1187–1192, *June*, 1929.

It is suggested that a particle does not adhere rigorously to a path determined by dynamical laws but instead moves in regions of greatest probability; hence all elements of motion are merely statistical quantities. By assuming the probability of the actual path's deviating from the geodesic, to be governed by a law similar to the Gaussian law of errors and choosing the modulus of precision suitably in terms of the de Broglie wave-length associated with an electron, it is shown that the Heisenberg uncertainty conditions are obtained. W. S. S.

66. Transition Probability between Two States with Positive or Negative Energy in the Central Field of a Nuclear Charge Ze. Y. Sugiura. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 193. [80 *pp.*] *June* 25, 1929.

A very complete account is given of the method of determining transition probabilities in a one-electron atom with nuclear charge Ze, the mathematical analysis being reproduced in considerable detail. The theory is based on the original Schrödinger wave equation, in which the matrix amplitudes are given by integrals involving the normalised wave functions. The calculation covers the three possible cases of transition (*a*) between two discrete states, (*b*) between a discrete and a continuous state, (*c*) between two continuous states. The results are used to compute numerically the number of dispersion electrons corresponding to the different lines and to the continuous spectrum in the Lyman, Balmer and Paschen series of hydrogen. The problem of the total intensity of the continuous X-ray spectrum is also attacked and among other applications may be mentioned the life period (Lebensdauer) of excited states of hydrogen, and absorption and dispersion in the X-ray spectrum. W. S. S.

67. Asymmetrical Top in Quantum Mechanics. S. C. Wang. *Phys. Rev.* 34. *pp.* 243–252, *July* 15, 1929.

An elaboration and a more complete analysis of Witmer's work on the asymmetrical top treated as a perturbation of the symmetrical one show that one can deduce the rigorous solution of the problem from those of the algebraic equations of degree $2j + 1$ or less. Without actually solving such equations, the terms divisible into even and odd groups are found just as in the case of the σ-type doubling in diatomic molecules treated by Kronig, van Vleck and others. For the case where the asymmetry is slight, an explicit expression for the separation of such similar doublets is obtained. The selection rules, which are rigorous for any degree of asymmetry, consist of the following: (*a*) Kronig's rule; (*b*) $\Delta j = 0, \pm 1$; $\Delta m = 0, \pm 1$; and (*c*) rule for the quantum number sigma, $\Delta\sigma =$ even for electric moment in z direction and $\Delta\sigma =$ odd for moment in $x - y$ plane. The effect of the electronic motions on the rotation of a polyatomic molecule as a whole is also briefly discussed. AUTHOR.

68. Quantum Theory of Electronic Scattering by Helium. N. F. Mott. *Cambridge Phil. Soc., Proc.* 25. *pp.* 304–309, *July,* 1929.

Born makes two assumptions in his theory of electron scattering by hydrogen [see Abstracts 2532 (1926) and 43 (1927)]. These are (1) the electron does not appreciably polarise the scattering atom, (2) the "distance of nearest approach" is small compared with the de Broglie wavelength of the electron. The errors introduced by these assumptions are discussed in particular for the case of electron scattering by helium. Born's approximations are used to find the scattering distribution for helium, and good agreement with Dymond and Watson's experimental results is obtained, better agreement in fact than the nature of the approximations would have led one to expect. W. S. S.

69. Dispersion Electrons in the One-Electron Problem. J. Hargreaves. *Cambridge Phil. Soc., Proc.* 25. *pp.* 323–330, *July,* 1929.

Uses Dirac's relativity quantum mechanics to derive the Kramers-Heisenberg dispersion formula for an atom with one electron; the treatment is quite general. An expression is found for the dipole moment due to incoherent scattering. The formulæ are similar to those of Klein for the case of a central field. The "sum" of the number of dispersion electrons for any state of the atom differs from unity by an amount of the order of 10^{-4}. London has shown that there is no such difference using the original Schrödinger simple wave equation; but it will be seen that the exact relativity treatment has a very small effect. H. N. A.

70. Attachment of Electrons to Neutral Molecules. L. B. Loeb. *Phil. Mag.* 8. *pp.* 98–102, *July,* 1929.

Discusses the criticisms by Bailey of the earlier work of Wahlin and the author on the subject, and shows that these writers had stated the limitations of their method and the assumptions involved as clearly as Bailey has done, and that the differences of the conditions under which the two investigations were carried out make a comparison of the values obtained impossible. H. N. A.

71. Recent Verifications of Wave Mechanics in the Case of Moving Electrons. M. de Broglie. *Soc. Franç. Élect., Bull.* 9. *pp.* 695–704, *July*, 1929.

The author sketches the development of the notion of " phase waves " and indicates how the experiments of Davisson and Germer, G. P. Thomson, and Rupp on the diffraction of electrons, support the theory. W. S. S.

72. Wave Mechanics of an Atom with a Non-Coulomb Central Field. Part IV. Further Results relating to Terms of the Optical Spectrum. D. R. Hartree. *Cambridge Phil. Soc., Proc.* 25. *pp.* 310–314, *July*, 1929.

The paper extends previous work [see Abstract 2918 (1928)], and in particular a method is developed for the direct calculation of the coefficient α of the Ritz correction term $\alpha\epsilon$ in the extended Ritz formula $q = q_0 + \alpha\epsilon + \beta\epsilon^2 + \ldots$ for the quantum defect in a sequence of terms of an optical spectrum. The somewhat elaborate calculations involved in the method are carried out by Hargreaves in another paper [see following Abstract]. W. S. S.

73. Some Calculations Relevant to the Quantum Defect in the Extended Ritz Formula. J. Hargreaves. *Cambridge Phil. Soc., Proc.* 25. *pp.* 315–322, *July*, 1929. [See preceding Abstract.] W. S. S.

74. Comparison of Whitehead's with Einstein's Law of Gravitation. W. Band. *Phil. Mag.* 7. *pp.* 1183–1186, *June*, 1929.

Temple has shown that the dynamic invariants of Whitehead's and Einstein's theories give precisely the same form to the equations of planetary orbits [see Abstract 2670 (1924)]. The author shows that Whitehead's first form of dJ^2 is only approximate and that the second is not even approximate unless, as is assumed, the metric is independent of the gravitation field. Einstein's dS^2 has been shown to be satisfactory even on this last assumption, and has the double advantage of simplicity and independence of the particular theoretical interpretation. J. S. G. T.

75. Dirac's Equations in the General Theory of Relativity. V. Fock. *Comptes Rendus*, 189. *pp.* 25–27, *July* 1, 1929.

Obtains an expression for Dirac's equation in the general theory of relativity. Arrives at an expression for the tensor of the energy of matter, and the equations of motion of the general theory of relativity. The variation of the mean deviation of the invariant of the tensor T of the invariant density of matter is equal to zero. This deviation itself is annulled in accordance with Dirac's equation; this agrees with the classical theory. H. N. A.

76. New Determination of Curvature Radius of Space-Time. L. Silberstein. *Nature*, 124. *p.* 179, *Aug.* 3, 1929.

A new estimate of the radius R of de Sitterian space-time is given based on data for 460 stars. The new value is $3 \cdot 63.10^{11}$ astronomical units (5·74 million light years) which agrees well with previous estimates $3 \cdot 0.10^{11}$ (29 cepheids), $3 \cdot 2 \cdot 10''$ (35 O-stars). The greatest possible distance in the universe cannot, therefore, exceed 9 million light years, and a number of astronomical distance estimates must be revised. W. S. S.

METEOROLOGY, GEOPHYSICS AND ASTROPHYSICS.

77. Association of Clouds. P. Villard. *Comptes Rendus,* 189. *pp.* 9–11, *July* 1, 1929.

A description is given of a cloud called by the author " cirrus adventif " which was seen as a thin fibrous layer forming a cap to a large cumulus, particularly on the side towards the sun. The layer slowly dispersed but after a few minutes reappeared. An explanation of the formation and disappearance of this cloud is given. R. S. R.

78. Atmospheric Ozone. G. M. B. Dobson. *J. de Physique et le Radium,* 10. *pp.* 241–246, *July,* 1929.

The quantity of ozone present in the atmosphere at any time being very small, the importance of obtaining accurate measurements of the ozone content is stressed. The spectroscopic methods adopted by various observers are described, and conclusions are drawn from the results of observations made under different meteorological conditions, in different latitudes and at different seasons. It would appear that a regular annual cycle exists in spite of general meteorological changes. Charts are given showing the distribution of ozone at centres of high and low pressure, and diagrams demonstrating the comparative values obtained in different latitudes at different seasons are also shown. In conclusion, the probable causes of the phenomena observed are discussed. [See also Abstract 2120 (1929).] J. G. H. B.

79. Relations between the Amounts of Ozone at the Ground and in the Upper Atmosphere. A. Lepape and G. Colange. *Comptes Rendus,* 189. *pp.* 53–54, *July* 1, 1929.

The authors compare the mean monthly amounts of ozone measured chemically at Paris from 1875 to 1908, with that found by other means for the upper atmosphere at Arosa in 1927. The former also shows an annual variation with a maximum in spring and a minimum in autumn while the mean amount is 1–2 mg./100m.^{3}. This indicates a greater concentration of ozone in the upper levels of the atmosphere. R. S. R.

80. Theory of Periodic Temperature Changes at the Earth's Surface. W. Smosarski. *Gerlands Beitr. z. Geophys.* 22. 4. *pp.* 400–409, 1929.

The author deals with the processes by which heat may be added to, or lost by, air near the ground and establishes a differential equation to represent the changes. He applies it to the hourly temperatures of the surface air at Irkutsk and calculates the amplitude of the waves of temperature and the phase delay at different parts of the day and year. It is also applied to the case of bright days in January and July. The equations agree also with observed facts at Tokyo, Katherinenburg and Tiflis. R. S. R.

81. Use of Darwin's Method in Periodogram Analysis. K. Stumpff. *Gerlands Beitr. z. Geophys.* 22. 4. *pp.* 410–441, 1929.

Two principal difficulties exist in practical periodogram analysis, (1) the necessary closeness of the periods requires that a sequence of integer periods must be completed by broken values; (2) each tentative period must be computed by a different calculating process. Darwin's method of tide analysis is applied in the computation of periodograms.

A matrix with a constant number of columns for all periods is prepared and filled out in a manner applicable in all cases. The difficulties in this method discussed by Pollak are removed while Darwin's method of avoiding them is supported. A method is worked out: (1) to compute the Fourier constants of a given number of ordinates, and (2) to construct periodograms of greater closeness than that of Fourier ordinates. The use of punched cards in statistical observations is particularly suitable for this process, and it is proposed to make a standard catalogue for the numbering of these cards. Finally, the use of a matrix of only two columns leads to the introduction of a "grating curve" as analysing function. This gives a periodogram furnishing a series of spectral lines instead of the simple lines of Schuster's periodogram, in the same way as does the optical periodograph. This method is simpler numerically, the disadvantages are small, and statistical machines can be used since only additions and subtractions are performed. R. S. R.

82. Determination of International Zero of Height Taking into Account the Law of Variation of Mean Annual Sea-Level. E. Prévot. *Comptes Rendus,* 188. *pp.* 1486–1487, *June* 5, 1929.

On account of oscillations of sea-level extending in period to 93 years the true sea-level cannot be deduced except by observations over a long period. Mostly at tidal stations the observations are of shorter duration, but by using the equation $\mu = M + \mu_n - M_n$, where M is the mean normal level calculated for a standard point, μ that for another point, and M_n and μ_n, the mean levels, obtained from several years of simultaneous observations, can be calculated. If this new post is to be used to fix the normal zero level for a country it must be made to coincide with the mean normal level calculated as above and thus to coincide with the international zero of height. R. S. R.

83. Dynamic Tides of an Ocean between Two Parallels. Law of Depth for any Latitude and Longitude. M. Brillouin. *Comptes Rendus,* 189. *pp.* 5–9, *July* 1, 1929.

The equations for the periodic motion of a homogeneous fluid ocean of any depth and density are established, and these are extended to include the areas near beaches and the continental areas and polar caps. R. S. R.

84. Properties of Certain Families of Curves. P. Delens. *Comptes Rendus,* 189. *pp.* 226–229, *July* 29, 1929.

Expressions are obtained for groups of curves of geodetics, curves of latitude and isotherms. The treatment is wholly mathematical. R. S. R.

85. Love Waves of Short Wave-Length. R. Stoneley. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 459–466, *July,* 1929.

Finds that the asymptotic formula for the wave-length of Love waves of short wave-length $2\pi/\kappa$ is $g_1 \sim 4\mu_0\kappa\sigma \cot\{\kappa J - \tfrac{3}{4}\pi\}$, where $\sigma = \left|\left\{\frac{c^2}{\beta^2} - 1\right\}^{\frac{1}{2}}\right|$, β is the local velocity of distortional waves, $J = \int_0^T \sigma dz$, $\beta = c$ at $z = T$, and g_1 depends on the rates of increase with z.

H. N. A.

86. Experimental Investigations of Deformation of Sand Mass. T. Terada and N. Miyabe. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 65–93, *June,* 1929. *In English.*

The results of a kinematographic study of successive stages of deformation are given for fine and coarse sand, closely and loosely packed, the experiments being along the lines of former tests [see Abstract 2396 (1929)]. These results are reviewed in the light of the mechanical theory of plastic deformation, by considering the distribution of the stress ellipse and its variation due to the deformation. The circumstances determining the formation of step faults are enumerated. The dynamical similarity between these sand tests and the earth crust is shown by (1) gravity mainly determining the stress ellipse; (2) the qualitative similarity of Mohr's diagrams; and (3) the mode of variation of the plastic property as a function of the rate of deformation. Geophysical applications regarding seismic activity and on a large scale for Japan and Korea and the formation of quasi-periodic slip planes in over-strained metallic crystals are discussed. R. S. R.

87. Tilting Motion of the Earth's Crust caused by Secondary Undulations of Tides in a Bay. R. Takahasi. *Tokyo Univ. Earthquake Research Inst., Bull.* 7. *pp.* 95–102, *June*, 1929. *In English.*

The paper forms a continuation of earlier work [see Abstract 2395 (1929)], and the results of observation of the tilting motion of the earth crust produced by seiches or secondary undulations of the tides in the Aburatubo and Moroiso Bays are given. A fundamental oscillation for sea water of 14–16 minutes was found, and superposed oscillations of about 7 minutes, and others of less than 35 minutes. It was found that the characteristic relation regarding effective rigidity of the crust holds for seiches as well as for tides. It was concluded that whether the load of a longer period will produce a greater tilting at a given station than that of a shorter period depends on the relative position of the station to the load, the period of variation of the load, and also on the functional form according to which the effective rigidity of the earth's crust at that station varies with the distance. R. S. R.

88. Explanation of Kursk Magnetic and Gravity Anomalies. H. Haalck. *Gerlands Beitr. z. Geophys.* 22. 4. *pp.* 385–399, 1929.

Former measurements [see Abstract 3286 (1929)] of local terrestrial magnetic anomalies proved that the direction of magnetisation of stratified masses corresponds with that of the normal earth's magnetic field. The present calculations show that the intensity of magnetisation depends on the geological formation and the induction of the earth's field. Magnetic anomalies at Kiirunavara (N. Sweden) are somewhat analogous to those at Kursk and support these views. The author opposes the views of Lasareff, Gamburzeff and Polokarpoff where the anomalies are attributed completely to iron quartzite, and he considers that the magnetic and gravity anomalies at Kursk are due to a high magnetite content probably at a depth of 500–1000 m. The most desirable point for the application of a deep boring is specified by a torsion balance method. R. S. R.

89. Critical Test of the Planetary Hypothesis of Sunspots. D. Alter. *Monthly Weather Rev.* 57. *pp.* 143–146, *April*, 1929.

Reference is made to an earlier analysis by the author of sunspot numbers using the correlation periodogram, in which it was shown that if a series of periodicities exist accounting for the main variations in sunspot numbers these must be harmonics of a period 252 years. A 250-year period is an almost perfect least common multiple of tidal periods of all planets from Jupiter outwards. The present investigation deals with the periods produced by the inner planets, and the calculated positions where these periodicities should show peaks in the periodogram agree excellently with the observed values. Thus, planetary action, presumably tidal, is the principal controlling factor in the number of sunspots observed. Several speculations regarding the effects of tides of stars on the sun and of the light changes in certain variable stars are made. R. S. R.

90. Composition of Sun's Atmosphere. H. N. Russell. *Mount Wilson Observat. Contrib. No.* 383. *Astrophys. J.* 70. *pp.* 11–82, *July*, 1929.

A survey of the quantitative analysis of the solar spectra and discussion of the existing evidence of the relative abundance and the absence of elemental lines. The author studies: the energy of binding an electron in different atoms into the same state, and gives tables (showing that it increases with the atomic number) and diagrams for neutral and singly ionised atoms (strikingly similar in general outline and in detail); the characteristics of the different elements' spectra (hydrogen being a glaring exception to the general rule); the ionisation potentials and the *raies ultimes*, both with tables. By aid of the calibration of Rowland's intensity scale, he enquires into the abundance of the solar elements, giving the numbers of atoms effective in different energy-levels, and discussing the data. He finds $\log A_1 = \log A_0 + 5040\,(I_0 - I)T^{-1}$ as defining the "level of ionisation" in a star's atmosphere, and gives a table for this for five elements in the Sun. From the constants thus obtained he computes the number M of atoms which are in any given energy state, neutral or ionised. He gives tables and diagrams for Q (the total mass of atoms or molecules per unit area) which indicate that the abundance diminishes with increasing atomic number and that even atomic numbers are more abundant than odd. He compares the solar elements with stony meteorites and with those on the earth's surface, and concludes that the calculated abundance of hydrogen is incredibly great; but if this is admitted, it clears up the difficulties from discordances of electron pressure and of the increase of density with depth in the reversing layer derived from different methods of observation. A. S. D. M.

91. Magnetic Field of the Sun. H. Deslandres. *Comptes Rendus*, 189. *pp.* 413–417, *Sept.* 16, 1929.

The general magnetic field of the sun above the chromosphere is of great importance. In 1911 the writer first measured its mean value, and found that it is extremely small, of the order of 10^{-7} gauss, and that it has a direction contrary to that of the earth. His estimate was based upon measures of radial motion in prominences made at Meudon from 1900 onwards, and especially prominences of spiral form. These are curved at their base into the direction of rotation of the sun, and their radial motion from base to summit is alternately positive and negative. The height of the spiral and the radial motions within it reveal the presence and strength of the magnetic field. Hale and the Mount Wilson astronomers discovered in 1913 a different general magnetic field of the sun, of far greater intensity, and existing only in the lower layers of the chromosphere, but they did not mention the weak field discovered at Meudon, and Hale has even stated that only the Zeeman method is capable of revealing a magnetic field at a distance. Recently, however, confirmation has come from the work of Chapman and of Evershed, the first being theoretical and the second observational, based on exact measures of numerous prominence spectra, scattered over many years. Since 1919, the spectroheliograms taken at Meudon have been greatly improved, and d'Azambuja has been successful in overcoming disturbances in the horizontal beam from the coelostat. The spiral filaments in prominences can now be clearly seen, and the direction of the magnetic field, indicated by the axis of the spiral, and its local perturbations, can be deduced. In the corona, local perturbations are slighter, and doubtless the magnetic field there is more regular. But in the corona there are streams of rapidly-moving electrons, which, proceeding towards the earth, produce auroræ and magnetic storms. These streams are slightly deflected from the vertical by a magnetic field of 10^{-7}, and this explains the lag of our magnetic storms behind the meridian passage of large spots. Störmer, in his research on the magnetic field based on the minimum corona with its characteristic polar jets, also finds a strength of 10^{-7}.

M. A. E.

92. Uniform Procedure in the Research on Planetary Figures. R. Wavre. *Arch. des Sciences*, 11. *pp.* 131–144, *May–June*, 1929.

Laplace and Poincaré in their works on the figures of equilibrium of a heterogenous fluid mass developed the inverse of the distance into the form of a series of Legendre's polynomes, and integrated this development in order to obtain the Newtonian force due to the matter present. Tisserand, however, showed that this method was not always correct, and the present author develops a formula whereby the conditions enumerated by Tisserand as necessary to ensure elimination of the errors are satisfied. It is assumed that the central portion of the star is removed, and a stratum round the periphery of the cavity thus formed is substituted. The point acted on must remain inside the cavity, and is consequently nearer to the origin, which is the centre of the star, than any point of action. The development obtained is then found to be always convergent, which is not so for the Laplace and Poincaré development. The method also allows of the obtaining of the principal classical results such as Laplace's theorem and Clairaut's equation. The paper is entirely mathematical.

R. C. F.

93. Influences of Meteoric Astronomy on Evolution. C. P. Olivier. *Frank. Inst., J.* 207. *pp.* 733–751, *June*, 1929.

After a description of the historical aspect the author inclines to the theories of the evolution of systems of comets and meteorites as stated in the planetesimal hypothesis of Chamberlin and Moulton. There is a discussion in detail of two special cases: (1) the meteor crater, Arizona, where the nucleus was very compact, and (2) the Coon Mountain and crater, Siberia, where the masses were widely scattered and none was large. It is concluded that (1) a large percentage of meteoric bodies come from outer space, and (2) the annual showers coming from groups following comets with known periods originated in the solar system. R. S. R.

94. Distribution of Absolute Velocities of G-Type Stars. J. M. Mohr. *Bull. Astronomique*, 5. 7. *pp.* 439–495, 1928.

The author adopts the absolute velocity

$$\nu = \sqrt{\xi^2 + (\eta - 17\cdot3)^2 + (\zeta + 10\cdot0)^2}$$

and confines himself to 519 stars of G-type of which 360 are giants. He gives tables and diagrams showing the relations of the absolute mean velocity ($\bar{\nu}$) to A_0 and D_0 (R.A. and Dec. of Apex) and to V_0 (Sun's motion) for giants and dwarfs; and finds that for A_0 and D_0 the giants and dwarfs behave similarly, indicating that the motions of the two fundamental groups of stars for absolute velocities of the same order are parallel in space and in the same direction, but this conclusion should be tested by the behaviour of other types. He discusses the law of frequency of absolute velocities and finds that the law given by Adams, Strömberg and Joy is confirmed for G-stars rather than Maxwell's law of the kinetic theory of gases. A " scatter diagram " shows the clear separation between giants and dwarfs; there is no single dwarf between 0 and 10 km. in absolute velocity. The most luminous stars have the smallest $\bar{\nu}$ (about 20 km.), the feeblest larger $\bar{\nu}$ (about 80 km.); for absolute magnitude $-1{\cdot}4$ to $+2{\cdot}5$ $\bar{\nu}$ is constant at about 33 km. Comparing his results with Kaburaki's for K-stars, he finds that the velocity ellipsoids for the two types are oriented in the same direction for giants and dwarfs, but the G velocity ellipsoid is more spherical. For the ratios of the three axes he gets for G-stars, 7:5:4 (giants) and 9:7:4 (dwarfs); for K-stars the ratios are respectively 7:5:3 and 3:2:1. A catalogue is given of absolute velocities and of their components both in equatorial and galactic coordinates. [See Abstracts 1128 and 1486 (1929).] A. S. D. M.

95. 61 Cygni Star Stream. H. Ludendorff. *Preuss. Akad. Wiss. Berlin, Ber.* 15. *pp.* 229–239, 1929.

In 1911 and 1912 Boss published a list of 57 stars which he thought were moving in the same direction and at the same speed as the famous double-star 61 Cygni, thus forming a star stream which was specially interesting because of its rapid motion of nearly 100 km./sec. Rasmuson, however, in a treatise published in 1921, showed that the radial velocities and parallaxes based on the proper motions and calculated from the supposed movement with the stream, when compared with observed velocities and parallaxes, agreed very badly or not at all, in very many of these 57 stars, and he was sceptical regarding the reality of the stream. Since then our knowledge of stellar data has greatly increased, and a fresh examination of these stars shows that all but 17 must be struck off the list, and many even of these are doubtful for different reasons. Moreover, the apex of the supposed stream lies very near the apex of Kapteyn's first star-drift, and also it is a suspicious feature that K giants as well as K dwarfs should be included in one stream. Finally, some stars added by Russell, Plummer and Corlin, are examined, and only a few of these can have any claim to be included. On the whole, therefore, it will be best for the present to omit 61 Cygni from the list of star streams. M. A. E.

96. Star Streams. J. Schilt. *Astron. J.* 39. *No.* 927. *pp.* 143–150, *Aug.* 20, 1929.

In previous papers the author has called attention to the second harmonic terms in the proper motions of every star catalogue which he has examined. The existence of these terms is beyond doubt, and must be due either to serious systematic errors affecting the fundamental catalogues, or to a cosmic phenomenon. It is here shown that it is not due to the former, since it is found in both proper motions and radial velocities; that it cannot be explained either by Oort's theory of differential galactic rotation, or by Schwarzschild's ellipsoidal distribution of motions in the star streams, or by the two intermingled star-streams of Kapteyn if the mingling is assumed to be constant throughout. But an unequal mixture of star streams in different regions of the sky, such as was suggested by Kapteyn and Frost, and abundant evidence for which has been adduced by Hough and Halm, would account for the second harmonics. There seems to be no other way of interpreting the observations, and in a later paper it is proposed to add some direct evidence for the theory of separate streams in contradistinction to the more generally accepted ellipsoidal theory. M. A. E.

97. Rapid Extract of Precise Photographic Position of a Wandering or Non-Catalogued Star. J. P. Lagrula. *Comptes Rendus*, **189.** *pp.* **88–90,** *July* **8, 1929.**

Discusses results obtained prior to publications by Wood and Comrie [*Journ. Brit. Astr. Assoc.* **39.** pp. **96** and **203, 1929**] on the same subject, in which the principle of the method is the same in each case. Schlesinger's method of dependences is used, and the special case $n = 3$ gives an extremely simple method for the estimation of a star's position. It is shown that this method of obtaining the position of a wandering star possesses advantages over the methods of Wood and Comrie. The exact limits between which the three stars can be chosen are also given.

R. C. F.

98. Velocities and Magnitudes of External Galaxies. H. Shapley. *Nat. Acad. Sci., Proc.* **15.** *pp.* **565–570,** *July*, **1929.**

Since 1918 it has been known that spiral nebula speed depends somewhat on apparent brightness, that is on distance or perhaps on mass, and this is supported by recent work at Flagstaff and Mt. Wilson. A table is given, and its columns described of the new photometric data for the extra-galactic nebulæ, and in a figure their reduced velocities are plotted against the quantity $10^{0\cdot 2m-2\cdot 0}$, which corresponds to a plot of velocity against distance in megaparsecs if space is assumed to be essentially transparent, and the absolute magnitude of a nebula is taken as –15. But for extra-galactic nebulæ, integrated absolute magnitudes, angular diameters or brightest stars are all treacherous indicators of relative distance; as, for instance, the Pleiades with an angular diameter of a degree at their present distance (500 l.y.) would appear, not as a group, but as a single star of great luminosity if placed in one of the Como-Virgo galaxies. The Holetschek-Hopmann visual magnitudes, when compared with the photographic, are too uncertain for individual extra-galactic nebulæ, but they do indicate the absence of light scattering in space. The author brings out three points: (*b*) If the observed-systematic drift of the nearer external galaxies is attributed to a galactic rotation about the Sagittarius nucleus, the mean corrected velocity for the seven nearest is only –20 km./sec., and the evidence is lessened that the Magellanic clouds are distinct from our galaxy; (*b*) our galaxy forms a local cluster with the Andromeda and some others; and (*c*) the total mass of the Virgo-Como cloud is comparable with that of our galaxy, which, however, is more compactly aggregated. A. S. D. M.

99. New Band System of Titanium Oxide. A. Christy. *Astrophys. J.* **70.** *pp.* **1–10,** *July*, **1929.**

Fowler has shown that the characteristic bands of the M-type stars are due to an oxide of titanium. They are usually referred to in the literature as TiO_2 bands. They extend in stellar spectra from λ4352 to λ7500. It has been shown by the writer that the bands occurring in the blue-and-green region of the spectrum are due to neutral TiO, and in particular to a $^3P - {}^3P$ electronic transition. In addition to the foregoing region, there were numerous unassigned bands in the yellow and red. These have now been arranged in a new system, whose lower level is the same as that of the blue-green system. There is evidence that Q-branches are present in these bands, indicating that the transition is probably a $^3P - {}^3S$. The frequency of vibration for infinitesimal amplitude is found to be 862·5 and 1003·8 cm.$^{-1}$, for the upper (initial), ^3S, and lower (final), ^3P, states, respectively. The moment of inertia of the molecule in the ^3S-state is estimated to be about $54{\cdot}8 \times 10^{-40}$ g.cm.^{2}. The corresponding nuclear separation is $1{\cdot}66 \times 10^{-8}$ cm. The heat of dissociation for the lowest level, with linear extrapolation, is 6·74 volts. These two systems are both resonance systems of the TiO molecule. It is known that the titanium bands persist in stellar spectra up to 3300 T°. At this temperature the product of the partial pressure of titanium and oxygen divided by the partial pressure of titanium monoxide is 10^{-3} atmosphere. Assuming that with the instruments used in stellar spectroscopy the titanium bands will not be observable if the ratio of Ti to TiO is as 100 to 1, it is found that the partial pressure of oxygen in stellar reversing layers is about 10^{-6} atmosphere. AUTHOR.

100. Some Problems of Cosmical Physics, Solved and Unsolved. (Lord) Rayleigh. *Science*, 70. *pp.* 77–84, *July* 26, 1929. *Address read before the British Assoc., Cape Town, July*, 1929.

The pair of unknown green lines N_1 and N_2 in nebular spectra has now been identified as due to doubly ionised oxygen. The green line of the aurora has been produced in the laboratory, but we do not yet know how to produce it alone or with only the negative nitrogen bands as produced in the sky, and there is an urgent need for an adequate wave-length determination of the red auroral line from a large-scale spectrogram. Coronium (in the solar corona) is almost certainly a known substance in a peculiar state, but the attempts to identify it with argon are not conclusive. The mode of excitation of the aurora is the subject of various interesting researches now in progress. No success has yet been obtained in imitating the nebular spectrum in the laboratory, but the source of excitation has been discovered to be stars of early type, emitting radiations of high frequency. General cosmic penetrating radiation has also been suggested. The dark patches in bright nebulæ show no selective absorption, unlike every opaque gas known to us; yet they can scarcely consist of meteorites or cosmic dust when so intimately mingled with bright masses of exceedingly rarefied gas. In comet spectra it is thought that the Swan bands of carbon are resonance bands excited by light from the sun at ordinary temperatures, yet, if so, it should be perfectly easy to imitate a comet in the laboratory, and this has not been done. Other questions discussed concern metastable states and forbidden lines, the problem of how ozone is generated in the atmosphere, and the possible existence of unknown elements of high atomic weight in the stars. Many possible points of approach to all these problems are opening to view, and pure science is reinforced by applied science, with all the resources of industry and finance. M. A. E.

LIGHT.

101. Absorption of Light by Fog. L. P. Granath and E. O. Hulburt. *Phys. Rev.* 34. *pp*. 140–144, *July* 1, 1929.

Measurements between two stations 0·4 km. apart with a thermocouple and galvanometer and with spectrograms, properly calibrated, of the absorption of light by fog for wave-lengths from 0·4 to 3 μ showed that the absorption increased slightly with decreasing wave-length, but hardly enough to indicate that red light is appreciably better than blue light for the purpose of penetrating fog. For a fairly dense fog, such that in daylight dark-coloured objects at about 0·6 km. could barely be seen, the distances necessary to reduce the light to 10^{-2} of its original value were about 710, 843, 910, 970, 980, and 980 metres for wave-lengths 0·4, 0·5, 0·6, 1·0, 2·0 and 3·0 μ respectively. AUTHORS.

102. Attenuation of Ultra-Violet Light by the Lower Atmosphere. L. H. Dawson, L. P. Granath and E. O. Hulburt. *Phys. Rev.* 34. *pp*. 136–139, *July* 1, 1929.

Measurements were made with a quartz mercury lamp, a quartz spectrograph and a recording densitometer of the attenuation of ultra-violet light from 3000 to 2050 Å. by the atmosphere at sea-level. For wave-lengths from 5000 to 3000 Å. the absorption was too slight to be observed at distances up to 400 meters; for wave-lengths below 2800 Å. there was pronounced absorption above that attributable to molecular scattering. The absorption was the same day and night, was unaffected by changes in the humidity, but increased with haze. The thicknesses of clear air necessary to reduce the light to 10^{-2} were about 22, 5, 0·57 and 0·20 km. for 2800, 2500, 2200 and 2050 Å., respectively. The absorption in the lower atmosphere around 2800 to 2900 Å. was not sufficient to account for the sharp cessation of the solar spectrum in this region. This result is in keeping with the fact that the ultra-violet limit of the solar spectrum is due to ozone in the high atmosphere. The absorption in the lower atmosphere at 2200 to 2050 Å., a spectrum region where ozone is relatively transparent, is great enough to prevent sunlight of these wave-lengths from penetrating to sea level. AUTHORS.

103. Absorption by Dialogite. P. Leroux. *Comptes Rendus*, 189. *pp*. 162–168, *July* 22, 1929.

The absorption of a crystal of dialogite ($MnCO_3$) for light of various wave-lengths from λ3655 to 5790 Å. is measured with the aid of a photo-electric cell. The absorption of the ordinary ray is much greater perpendicular to the optic axis than parallel to it. W. H. GE.

104. Piezochromy (Change of Colour under Pressure) with Natural Minerals. K. Przibram. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 5–6. *pp*. 263–269, 1929.

The changes in colour of Wölsendorf fluorite under pressure are confirmed, and further experiments with other fluorites and calcites described. In general, green or blue fluorites assume a violet shade under pressure, whereas the yellow and red forms do not change appreciably in colour. Yellow calcite from Joplin (Missouri) becomes sensibly, although very slightly, bluish-green. Possible explanations of this phenomenon are discussed [see Abstract 1872 (1928)]. T. H. P.

105. Recrystallisation and Coloration of Rock-Salt. K. Przibram. *Akad. Wiss. Wien, Ber.* 138. *2a.* 5–6. *pp.* 353–362, 1929.

A method is given for rendering visible the recrystallisation of pressed rock-salt, and following its course by coloration. With moderately pressed portions at room-temperature, the velocity of growth of the recrystallisation zones is about 0·1 mm. per day. Under high pressures, intense radiation retards the recrystallisation, but with lower pressures it appears to accelerate the effect. The recrystallisation increases in rapidity with the pressure employed and with the temperature. A temperature-time diagram of recrystallisation is sketched for temperatures between room-temperature and 300° C., the pressure to which the salt was subjected being 2000 kilos per sq. cm. The results support Smekal's views [see Abstract 1031 (1928)] regarding the recrystallisation as a function of the pore-ions (Lockerionen) [see also Abstract 1872 (1928)]. T. H. P.

106. Periodic Series of Colour Sensitivities. R. Ehrlich and R. Schumann. *Akad. Wiss. Wien, Ber.* 138. *2a.* 5–6. *pp.* 245–261, 1929.

In the first part, by Ehrlich, it is shown that the series of the colour sensitivities can be represented by a periodic series of the form $+a$, $+a+c$, $+c$, $-a$, $-a-c$, $-c$, etc., where $+a$ and $-a$ represent the complementary colour pair red and blue-green, whilst that of yellow-green and violet are represented by $+c$ and $-c$. Thus, the total series of the colour sensitivities of the Hering theory is reduced to one of two complementary colour pairs. The complementary colours are not opposed to the assimilation and dissimilation processes, but all colour and light sensitivities are expressions of a decay occurring in the two-part nerve element. After this decay has effected the relatively separated two parts of the nerve element, either by equal amounts or by different values, it leads to a colourless or a colour sensitivity respectively. The Young-Helmholtz theory states that the complementary-coloured after-effects are due to prolapsus phenomena, or retinal fatigue. This is not correct, as they are actually expressions of the spontaneous after-decay of the second, or non-excited, part of the light-sensitive material, after excitation decay of the first part. The colourless negative after-effects only represent fatigue phenomena after equal decay of both parts. The second part, by Schumann, is an Appendix, in which the above series for the colour sensitivities is mathematically examined. R. C. F.

107. Laws for the Establishment of Chromatism of Luminous Impressions. H. Piéron. *Comptes Rendus,* 189. *pp.* 194–197, *July* 22, 1929.

Tests were made photometrically with the help of a spectro-colorimeter on the relative intensity, purity and wave-length of light at which colour could be perceived. It was found that colour was not detected if the exposure to the eye was below a certain duration. This duration depends upon the wave-length decreasing through the spectrum from red to blue. It is increased by additional intensity of the light, but is approximately the same for different degrees of purity. R. S. R.

108. Colour Sensitivity. G. N. Hunter. *Roy. Soc. Edinburgh, Proc.* 49. 3. *pp.* 232–244, 1929.

The author selected red, green and blue units such that superposition gave white light. These were arranged at the corners of an equilateral triangle as for Maxwell's diagrammatic representation, and all other colours are given by appropriate points in the triangle. In the measurements of colour sensitivity, light passes through a slit at the focal distance from a lens, and then through two other slits each covered by a movable tricolour screen (red, green and blue) to be focussed by another lens on a ground-glass screen. The images are separated by a biprism. It is concluded from the tests that (1) the juxtaposition of the coloured areas increases the sensitivity; (2) the greater maxima occur at the blue corner, the smallest at the green corner and above the "white point" in the triangle; (3) a cursory examination of the colour sensitivity of the observer gives an estimate of the general distribution, and a more particular examination a diagram of the local distribution of colour sensitivity over the observer's colour triangle. R. S. R.

109. Effect of Silvering a Plane Parallel Plate. L. W. Blau and R. R. Thompson. *Zeits. f. Instrumentenk.* 49. *p.* 416, *Aug.*, 1929.

Briefly describes the results obtained after silvering the under-side of a plane parallel plate, which confirm those obtained by Lau [see Abstract 2152 (1929)]. The silvering greatly increases the reflection power of the plate, whilst two bands are also observed, one of which is vertically, and the other horizontally, polarised. Both band systems have the same intensity, and show also six satellites of the mercury line λ5461, whilst from measurements on the disappearance of the satellites it is shown that the vertically polarised system is the one which suffers the least number of reflections at the silvered surface. Double refraction can be obtained when the phase difference produced by the reflections is different for the two rays producing the interference bands. The rays coming from the silvered plate are found to be elliptically polarised. For the non-silvered glass the interference bands are sharpest when horizontally polarised light is used. Two band systems can also be obtained, as with the silvered plate, but in this case they are almost superimposed, and cannot be separated. R. C. F.

110. Dependence of Ultra-Violet Reflection of Silver on Plastic Deformation. H. Margenau. *Phys. Rev.* 33. *pp.* 1035–1045, *June*, 1929.

The change in electrical conductivity of metals with mechanical strain suggests the possibility of a dependence of optical reflecting power on plastic deformation. To study this matter, and to obtain additional evidence with regard to the nature of cold working, the behaviour of the minimum of reflecting power of silver in the near ultra-violet (at 3160 Å. according to Hagen and Rubens) was examined for silver surfaces of varying degrees of strain, produced by vigorous and moderate polishing, etching and electroplating. Reflection curves were obtained by measuring directly, by means of two quartz photoelectric cells, incident and reflected intensities. It is shown that the minimum is very low and lies at 3160 Å., in accordance with Hagen's and Rubens' measurements, only for highly polished plates. For unstrained surfaces it is shifted to lower wavelengths by about 20 Å. and the reflecting power rises appreciably. The results presented in the paper, as well as other allied phenomena, are accounted for by assuming a change in the number of free electrons and a consequent change in the index of refraction of the metal. AUTHOR.

111. Optical Constants of Metallically Reflecting Substances in the Infra-Red. C. Boeckner. *J.O.S.A. and R.S.I.* 19. *pp.* 7–15, *July*, 1929.

The reflecting power for infra-red radiation (from a Nernst filament), polarised in the plane of incidence by a selenium mirror, is measured at two angles of incidence (5° and 68°), and the refractive index (ν) and extinction coefficient (κ) deduced therefrom by Fresnel's reflective power formula. The method, which is applicable to amorphous substances and, for the "ordinary" ray, to uniaxial crystals, is applied to the determination of these constants for fused and crystalline quartz for their bands of metallic reflection at 8–10 μ; the variations of both constants with wave-length are shown by curves. The following exemplify the results:

λ	κ (Crystalline Ordinary Ray).	κ (Fused).	ν (Crystalline Ordinary Ray).	ν (Fused).
8·13	0·32	0·94	0·40	0·40
8·38	7·3	1·63	0·12	0·52
8·50	10·0	1·90	0·15	0·49
8·63	4·0	2·3	0·29	0·45
8·83	27·0	4·3	0·05	0·38
9·38	2·0	0·75	3·0	3·7
9·50	—	0·50	3·9	3·9

C. A. S.

112. Reflecting Power of Some Substances in the Extreme Ultra-Violet. P. R. Gleason. *Nat. Acad. Sci., Proc.* 15. *pp.* 551–557, *July,* 1929.

Fifteen substances have been investigated between 585 Å. and 1850 Å.; no data existed in this region at discreet values of the wave-length. The general optical arrangements of Hulburt were used in a vacuum spectrograph. In the final measurements the times of exposure of the direct and reflected spectra were adjusted so as to give the same opacity of the spectral line image produced by light from a discharge tube with the gases H, He, O and N. The reciprocity law was tested by means of a rotating sectored disc. The chief sources of error are considered. The numerical results obtained are in general agreement with the qualitative results of Gardner. The work of Pfund, of Hulburt, and of Lewis and Hardy is considered. Graphs are given showing the reflecting power of the substances tested at different wave-lengths; platinum is seen to be by far the best reflector at 585 Å.; beryllium is unique in showing a deep minimum at about 1640 Å.—probably the index of refraction passes through the value unity at this wave-length, and the absorption is relatively low; chromium is the best reflector for wave-lengths longer than 1400 Å. For other substances the original paper should be consulted. H. N. A.

113. Optical Studies of Potassium Lithium Sulphate. H. Blittersdorf. *Zeits. f. Krist.* 71. 3. *pp.* 141–168, 1929.

The refractive indices are between 1·4679 and 1·4798. The double refraction was investigated by the method of spectral interference. It was found to be about one twentieth of that of quartz. Investigation of the effect of temperature showed that the double refraction increased fivefold, from 0° C. to 435° C., and then through transformation of the crystal doubled itself. The colour effects in crossed Nicols were also studied in detail. J. E.

114. Anisotropy of the Polarisation Field in Liquids. K. S. Krishnan and S. R. Rao. *Indian Journ. Phys.* 4. *pp.* 39–45, *July*, **1929.**

The Lorentz polarisation field is only applicable to liquids (*a*) if the distribution of molecules surrounding the one under consideration is spherically symmetrical, and (*b*) if their orientations with regard to it are quite fortuitous. Recent work on the structure of liquids by means of X-rays shows that in the case of asymmetric molecules spherical symmetry of distribution is not realised. Thus, the value of the polarisation field varies with the direction of the incident field and is therefore anisotropic. The value of this anisotropy is evaluated from X-ray data and from light-scattering data for some typical liquids. The influence of density is considered, and it is shown that the anisotropy approaches a maximum value at high densities and a minimum value at very low densities.

J. E.

115. Photodichroism and Photoanisotropy. Part III. F. Weigert. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 83–112, *June*, 1929.

The phenomena of induced photodichroism [see Abstract 3313 (1929)] in developed photographic films are complicated and the effects influenced by a number of means such as composition and preparation of film, manner of development and fixing, dryness or wetness of film, time and colour of exposure to light. It is suggested that *micelle* deformation plays an intermediate part in some unknown processes [see also succeeding Abstract]. J. E.

116. Photodichroism and Photoanisotropy. Part IV. F. Weigert and E. Elvegård. *Zeits. f. phys. Chem.* 4. *Abt. B.* 4. *pp.* 239–257, *July*, **1929.**

A further study of these effects [see preceeding Abstract] in photochloride gelatin with monochromatic light. Spectral analysis of the dichroism shows that there is complete colour adaptation for all colours of the exciting light. It appears, however, that the curves for long-wave and short-wave excitation are quite different, and that between the two there lies an indifferent region for which the film is only weakly dichroitic. This is taken to indicate antagonistic effects of different kinds of light, and is discussed in relation to *micelle* deformation. J. E.

117. Photodichroism and Photoanisotropy. Part V. F. Weigert and M. Nakashima. *Zeits. f. phys. Chem.* 4. *Abt. B.* 4. *pp.* 258–276, *July*, 1929.

Examination of the form of the dichroitic curves of films of dyestuffs under excitation with polarised light indicate two different effects. With weak excitation quite sharp colour adaptation is found which is not influenced by the special form of the extinction curve of the dyestuff. With strong excitation the extinction curve is the predominating factor, and the specific effect of the different exciting colours does not enter in. As with the photochlorides, there are antagonistic effects of the long and short waves. The relation of the new effects to the known photochemical properties of the dyestuffs is discussed. J. E.

118. Elliptical Polarisation Produced by Reflection at the Surface of Aqueous Solutions of Fatty Acids. C. Bouhet. *Comptes Rendus*, 189. *pp.* 43–45, *July* 1, **1929.**

Extends the results previously obtained for the ellipticity of fatty acids up to saturated acids containing 10 atoms of carbon in the molecule [see also Abstract 1510 (1929)]. Results are also given for hydrochloric acid as well as water, and no difference can be detected in the ellipticity values obtained. The value of the area occupied by each molecule of acid at the surface is found to be approximately 25 × 10^{-6} cm.^{2} for all the acids, which agrees with the results of Adam. Gibbs and Morrow have shown by X-ray examination that in acids containing above 3 atoms of carbon in a molecule the length of the molecule grows linearly with the number of atoms of carbon, but there is a sharp change below 3 atoms. The present author's results are exactly parallel, for above C_3 the limiting ellipticity decreases regularly with increasing carbon values, whilst for C_1 and C_2 it is impossible to fix the minimum ellipticity. These results confirm Langmuir's hypothesis that the molecules of fatty acids are oriented perpendicularly to the liquid surface. R. C. F.

119. Quantitative Relations in Natural Optical Activity. W. Kuhn. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 14–36, *June*, 1929.

Even with substances with high rotatory power the refractive indices for right and left circularly polarised light differ only by an amount of the order of one-millionth part. If this difference is regarded as being due to the effect of absorption bands in the ultra-violet it is necessary to suppose that the effects of many of the strong bands far out in the ultra-violet counteract one another, since single weak bands should theoretically be quite sufficient to produce the difference in the refractive index required. A theory is put forward which attempts to explain matters by considering the quantitative relations between the parameters of the optical activity, and by discussing the dependence of these parameters on the mutual action between the constituents of the molecules. A quantitative relation is shown to exist between circular dichroism and the rotatory power within and outside the absorption bands. H. N. A.

120. Rotation Dispersion of Optically Active Ammonium Salts. E. Wedekind and G. L. Maiser. *Zeits. f. Elektrochem.* 35. *pp.* 438–440, *July*, 1929.

Especially from the point of view of anomalous behaviour, the rotation dispersion of many compounds, optically active owing to the presence of asymmetric carbon, has been investigated, but no similar observations have been recorded for compounds, the optical rotation of which depends solely on the presence of asymmetric nitrogen. Measurements of the optical activity of solutions of *d*- and *l*-phenylbenzylallylmethylammonium iodides, *d*-camphorsulphonates, nitrates, and hydroxides in various solvents, and for different wave-lengths, fail to reveal any anomalous rotation-dispersion or any influence due to the solvent. Similar normal behaviour is shown by acetone solutions of methylallyltetrahydroquinolinium iodide and by the two stereoisomeric *l*-menthyl propyltetrahydroisoquinolinium iodide acetates, which contain an asymmetric carbon atom in addition to asymmetric nitrogen. T. H. P.

121. Magnetic Birefringence in Liquids of the Aliphatic Series. M. Ramanadham. *Indian Journ. Phys.* 4. *pp.* 15–38, *July*, 1929.

The liquid was contained in a tube placed in the gap of an electromagnet. The pole-gap was 33 cm. long and 1 cm. square, and the field was 21,000 gauss. Magnetic birefringence was observed and measured in thirty liquids belonging to the aliphatic series. Saturated compounds and their derivatives as a rule showed negative double refraction. Water was also found to belong to this class. Compounds containing the carbonyl group exhibit positive birefringence. The paper also presents some calculations of magnetic anisotropy of organic molecules, and the calculations show that aliphatic molecules are very feebly anisotropic in comparison with the molecules of aromatic compounds. G. E. A.

122. Determination of Velocity of Light by Kerr Effect. O. Mittelstaedt. *Ann. d. Physik*, 2. 3. *pp.* 285–312, *July* 15, 1929.

Full details are given of the theory and the experimental method used while the several possible sources of error are discussed. The mean value obtained for the velocity of light is 299,778 km./sec. with a probable error of ± 6 km./sec. This compares with Michelson's value (299,796 ± 4) km./sec. obtained by optical means, and Rosa and Dorsey's value 299,790 km./sec. by electrical means. Further tests are contemplated in which smaller errors should occur. [See also Abstract 2449 (1929).] R. S. R.

123. Velocity of Light. H. Maurer. *Phys. Zeits.* 30. *p.* 464, *July* 15, 1929.

Referring to the table of the values found for the velocity of light given by Mittelstaedt [see preceding Abstract], the author suggests that perhaps a one-sided source of error exists which with improved observations results in smaller values being found. The mean of the measurements between the years 1874 and 1882 gives the average value 299,818; 1900–1902, 299,813; and 1924–1928, 299,774 km./sec. J. J. S.

124. Obliquity Factor Used in Approximate Theory of Diffraction. W. R. Harper. *Cambridge Phil. Soc., Proc.* 25. *pp.* 289–303, *July*, 1929.

The obliquity factor to be used in applying Huyghen's principle to obtain an approximate theory of diffraction is subjected to the requirement that it must give the right result in the case of an undiffracted plane wave, by integration over the wave-front. Although almost any function which makes the integrals converge will satisfy as regards distant points, for complete agreement the obliquity function must be a constant, in which case the integrals do not converge. In any actual case, therefore, the boundaries must be taken into account, and it shows that, using a constant obliquity factor and using a boundary distributed in a Gaussian way, correct results are obtained. The case of diffraction by a straight edge is solved in detail, the usual result being obtained. Use of the method in teaching is indicated. W. S. S.

125. Interference Effect Due to Disturbance of a Fluid Surface, and Surface Tension. Z. W. Wolkowa and W. S. Titow. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 71–82, *June*, 1929.

Further measurements of the effect described previously [see Abstract 2155 (1929)] are given for water solutions of $CaCl_2$, $MgCl_2$, LiCl, NaOH and KOH, respectively, for different concentrations of the salt. The effect of increasing the concentration was in all cases to make the interference effect more stable and of longer duration. The maximum separation of the interference system from the undeviated image was found to vary linearly with the concentration. The results are explained in terms of the theory previously advanced, and a relation with the surface tension of the solution is introduced. W. S. S.

126. Image of a Wire using Parallel Light. C. Lakeman and J. T. Groosmuller. *Ann. d. Physik,* 2. 1. *pp.* 123–128, *June* 7, 1929.

Extends previous work on the same topic [see Abstracts 2443 and 2444 (1929)]. W. S. S.

127. Simplified Derivation of v. Seidel's Aberration Formulæ, Parts I. and II. A. O. Allen. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 392–401, *April, and pp.* 475–483, *July,* 1929.

The case of a single spherical surface is first treated to show that there are five varieties of aberration easily distinguishable on reasonable and practical grounds. These consist of (1) spherical aberration, (2) coma, (3) astigmatism and curvature of the field, and (4) distortion, at the refracting surface, and (5) curvature of the field near the focal plane. In a *résumé* of the Seidelian process the method is applied first to the case of a distant point object, only one surface and a common direction parallel to the principal axis, and extended to the case of points at any distance from the axis out of the meridian plane and any centred combination of spherical surfaces. In the method the reduced aberration is carried forward stage by stage to successive surfaces. Examples are given of the application of the formulæ. R. S. R.

128. Teaching of Geometrical Optics. *Phys. Soc., Proc.* 41. *pp.* 258–340, *June* 15, 1929.

A series of papers on the subject by **T. Smith, C. W. Hansel, S. R. Humby, H. H. Emsley, G. F. C. Searle, C. V. Drysdale, V. T. Saunders, C. G. Vernon, L. Moore, H. Tunley, C. Beck, W. E. Williams, G. C. Steward, J. W. French** and **T. Y. Baker,** together with a general discussion by various contributors.

129. Determination of Angles by the Use of Microscopic Areas. A. Arnulf. *Comptes Rendus,* 189. *pp.* 152–153, *July* 22, 1929.

The object of the device is to determine to an accuracy of 1′ the direction of the normal to a polished surface of small radius of curvature (*e.g.,* 0·01 mm.) by means of an observation on a very small area (*e.g.,* 0·001 mm.^{2}). A luminous point situated laterally is by means of an unsilvered plate of glass placed at an angle of 45° in the optical axis of a microscope, reflected through the object glass on to the polished surface under examination, and thence back to the eye. The variations in the resultant illumination reaching the eye according as the tangent plane to the surface at the point of incidence of the pencil of light is, or is not, accurately perpendicular to the optical axis of the microscope, enable the direction of the normal to be accurately determined. C. A. S.

130. Illumination Diagram to Produce Optical Equality. H. Siedentopf. *Zeits. f. Physik,* 56. 5–6. *pp.* 397–401, 1929.

Employing the Abbe laws for the formation of microscope images the case of optical equality for images of a double slit having direct illumination, or that inclined to the optic axis, is taken. The results are set out in the form of a diagram of illumination as a quadratic linear system. R. S. R.

131. Surveying Level. *Rev. d'Optique,* 8. *pp.* 274–277, *June–July,* 1929.

Describes a new form of level adopted by the Service du Nivellement Général de la France. The chief characteristics of the instrument are:

bubble sensitivity, 2 seconds; magnification of telescope, × 30; aperture of objective, 50 mm.; length of telescope, 32 cm.; total weight, 10 kg.
J. W. T. W.

132. Recording Infra-Red Spectrometer. P. Lambert and J. Lecomte. *Comptes Rendus*, 189. *pp*. 155–158, *July* 22, 1929.

The spectrometer embodies two 30° prisms of rock-salt, of which the one is fixed, while the other is mounted upon a movable table which carries one of the concave mirrors and the thermopile. The recording device consists of a table carrying sensitive paper upon which the galvanometer spot is recorded in the usual way through a slit. The table is moved past the slit by a screw and carries in addition a cam and lever which operate the spectrometer table. The advantage claimed is the absence of clockwork and gearing, the latter introducing lost time. F. S.

133. Recording Apparatus for Infra-Red Spectroscopy. O. Reinkober. *Zeits. f. techn. Physik*, 10. 7. *pp*. 263–268, 1929.

Describes auxiliary apparatus which is extremely useful for recording work in infra-red spectroscopy. For satisfactory operation such auxiliary apparatus should be of use with any type of spectrometer, without necessitating any alteration in the construction. It should also be possible to change from photographic recording to visual observation of the spectrum without dismantling any of the apparatus. Further, the auxiliary apparatus should be capable of changing the wave-length region under examination, releasing the shutter and definitely recording the exact moment of both the opening and the closing of the shutter. The apparatus described consists of a recording cylinder which is clock-driven and has a contact make and break, apparatus for varying the wave-length, again clock-driven, which alters the angle of incidence at the prism surface by direct, although distant, drive, and a time relay for opening and closing the shutter. The three pieces of apparatus are electrically interlinked, and the conditions for satisfactory operation are fulfilled. R. C. F.

134. Apparatus for Strong Ultra-Violet and Infra-Red Light and Photography of Heat Rays. J. Plotnikow. *Zeits. f. Elektrochem.* 35. *pp*. 434–438, *July*, 1929.

Three types of apparatus are described, using carbon arc sunlight and magnesium. The applications of the apparatus are indicated. J. E.

135. Mercury Spark Gap for Instantaneous Photography. L. F. Curtiss. *Bureau of Standards, J. of Research*, 3. *pp*. 53–55, *July*, 1929.

The improved form of high voltage mercury spark gap for instantaneous photography here described eliminates dangers from mercury poisoning. By including a bulb of cooler mercury vapour, through which the discharge does not pass, the shock caused by the sudden rise of pressure in the enclosing tube is partially absorbed. This greatly prolongs the life of the enclosing tube. It has been found that pyrex glass is quite suitable as a container. AUTHOR.

136. Preparation and Sensitisation of Photographic Plates of Very Fine Grain. N. Leroy. *Rev. d'Optique*, 8. *pp*. 262–274, *June–July*, 1929.

This paper describes a new process, starting from colloidal silver, of manufacturing photographic plates of very fine grain, which enable spectra of remarkable clarity to be obtained comparable to those given by the

Lipmann emulsion. The different properties given by the chloride, bromide and iodide of silver are summarised and discussed. A comparative study of the opacity curves shows that the sensitivity is a maximum for a well-defined wave-length λ in each of the three cases, and that λ depends on the molecular weight of the salt utilised. After constructing characteristic curves for each emulsion for a certain number of points of the spectrum, the author studies variations of the factor γ as a function of λ, and concludes that these plates, having the properties of ordinary plates, may be made sensitive to every radiation, and so be utilised for colour photography. H. H. Ho.

137. Positioning of Negatives in Stereoscopic Recombination Apparatus. G. Poivilliers. *Comptes Rendus*, 189. *pp.* 146–149, *July* 22, 1929.

In the problem of surveying by aerial photography, the question of placing the negatives in the recombining apparatus is of very great importance when the details of the actual photography are unknown. The author, in this paper, gives a rigorous and practical method for determining the coordinates of the view and of the three parameters of orientation of each negative. It is assumed that the approximate values of the six positioning parameters and of the coordinates of at least three points in the area portrayed on each negative are known. The recombining apparatus is then used to determine the coordinates of the intersections of the viewing lines of the known points, obtained in various ways dependent on the type of apparatus used, with the corresponding approximate distance planes. This paper is mainly mathematical. R. C. F.

138. Effective Aperture of Photographic Objectives. J. Hrdlicka. *Comptes Rendus*, 189. *pp.* 153–155, *July* 22, 1929.

The method adopted consists in setting a light source at the focus of the lens and taking a photograph by placing the plate close to the lens. The distance of the light source is then found at which, when the lens is removed, it gives the same blackening on the plate. For a particular lens of nominal aperture 4·5 an effective aperture of 5·54 was found. F. S.

139. Physical Development and Nature of the Latent Image. R. E. Owen. *British Phot. Research Assoc. Lab., Comm. No.* 71. *Phot. J.* 69. *pp.* 278–280; *Disc.*, 280, *June*, 1929.

Lumière and Seyewetz described some experiments whereby they claimed that the photographic latent image does not consist of silver, but of some modification of silver bromide. Their experiments were carried out on plates exposed, fixed, washed and finally physically developed. Eggert has stated that plates, after treatment with a sodium thiosulphate solution containing silver, give several times the quantity of silver originally present, whilst Kieser [see Abstract 470 (1929)] has shown this added silver to be in the form of silver sulphide. Thus it appears that the latent image, after such treatment as Lumière and Seyewetz gave it, will exhibit the properties of silver sulphide. This the author shows to be true, for experimental results on plates coated with colloidal silver sulphide in gelatin and physically developed with Lumière's developers give identical results to those given by Lumière and Seyewetz. The fact that the developers used were correct was shown by the reproduction of the results for ordinary plates. Lumière and Seyewetz were consequently not dealing with the original latent image, and the theory that the latent image consists of metallic silver is still apparently correct. In the *Discussion*, **O. Bloch** suggested that light might be thrown on the subject if a fixing solution which did not contain silver in the sulphide yielding form were used.

R. C. F.

140. Principles and Practice of Fixation. *Phot. J.* 69. *pp.* 310-318, *July*, 1929.

These papers form part of a general discussion on the above subject. **F. F. Renwick** commenced by dealing generally with fixation. It is shown that excess of sodium thiosulphate is essential for good fixation. Temperature is also important, as is the quantity of silver salts already dissolved in the solutions. The effect of the various silver halides on the activity of the fixing bath and a summary of the factors influencing the rate of fixation are also given. It is finally suggested that the activity of a fixing bath should always be tested, and the means of doing this are discussed. **Clark** suggested that the velocity of diffusion of the salts in the gelatin layer, and also grain size, affected fixation, but **F. F. Renwick** stated that grain size had no apparent effect. **H. Baines** deals with the chemistry of fixation, and discusses fully the reaction between sodium thiosulphate and silver halides. Previous results do not give conclusive evidence in favour of these reactions, and a new set of reactions is given which agree with the authors' results. The question as to how insoluble salts of silver can react to give soluble products is considered from the ionic theory of fixation, which is that silver halides dissolve in sodium thiosulphate solutions to give complex argento-thiosulphuric anions and halogen anions, whilst the complex silver anions also dissociate to a minute extent, yielding silver kations and thiosulphate anions. This theory is still imperfect, although explaining several peculiar reactions. **D. A. Spencer** shows that generally the removal of thiosulphate is exponential with time, the only exception being the case when the fixing baths contain alum as a hardener. It is also stated that fixing is not complete when the milkiness has just disappeared, but further experimental results suggest that the fixing is then complete. Salts are removed from the washing water to replace those absorbed in the film, and thus when an acid fixing bath is used the washing water should be on the alkaline side of the iso-electric point. Finally, thiosulphate is more easily removed from acid fixed plates than from those treated with plain hypo, possibly due to the smaller swelling of the gelatin. R. C. F.

141. Limitations of Colour Photography. H. M. Cartwright. *Phot. J.* 69. *pp.* 323-325; *Disc.*, 325-327, *July*, 1929.

Briefly reviews the simple principles on which colour photography is based, before considering the limitations of the two methods, " additive " and " subtractive," of photographing objects in colour. In both cases filters have to be used, and these form one of the limitations, although they are now made almost perfect. In the " additive " method there is a certain amount of darkening of the colours due to the small amount of light transmitted. The " subtractive " process is seen at its best when the prints are made of a dyed transparent medium and viewed by transmitted light. The difficulty of producing good colour prints is to be found in the printing inks which have to be used. In the *Discussion*, **F. J. Tritton** emphasised the fact that in photogravure too much retouching was done, and also that the use of perfectly transparent dyes gave rise to extreme accuracy in every stage of the process; **A. J. Bull** stated that with greens and blues there was always a darkening of colour, whilst pinks and purples lost their blue hues, which, he thought, was mainly due to the printing inks used; **Hibbert** remarked that a great limitation of colour photography was that the amateur could only get one successful reproduction. R. C. F.

142. Photographic Effect Produced by Sterols after Exposure to Ultra-Violet Rays. J. Cluzet and Kofman. *Comptes Rendus*, 189. *pp.* 45–47, *July* 1, 1929.

The sterols, after subjection to the action of ultra-violet radiation, are capable of affecting photographic plates. The authors have previously shown that for cholesterine and ergosterine this action is not due to radiations emitted by the sterols, as the interposition of glass and quartz entirely suppresses such action. Thus the photographic effect must be caused by very short waves, and this is further supported by proof that the radiations are not luminous. Phosphorescence cannot be the cause, for quartz would not then suppress the effect of ultra-violet radiation of 3000 Å. No action is produced on the radiation by a magnet, and a charged electroscope is not affected, so that the radiations are not negatively charged particles, or the like. Further results are given in the present paper regarding this photographic action, and it is shown that small troughs of irradiated substance completely covered with a sheet of non-radioactive quartz, or a pellicle of cellophane, do not produced any effect. Should the troughs be left partially covered, then the plates are acted upon only by the part uncovered. Heating the irradiated substance destroys the action for cholesterine, and greatly reduces it for ergosterine. These results do not support the phosphorescence hypothesis, but tend to support the theory that ultra-violet radiation produces a gaseous product. X-rays and radium emanation also produce similar effects. R. C. F.

143. Photochemical Activity of Various Sterols, and Nature of Their Action. L. Hugounenq and E. Couture. *Comptes Rendus*, 189. *pp.* 47–49, *July* 1, 1929.

Shows that for sterols exposed to the diffuse light of the laboratory and not subjected to a definite radiation, only those of cod-liver oil, Bombyx and brewers' yeast affect a photographic plate. The action due to the cod-liver oil sterol disappears after a month in complete darkness. Other sterols, such as those from roe oil, red or fresh herrings, rye spur, snails, ox blood and brain, are found to be inactive to diffuse illumination. A month's insolation under a thin cellophane membrane produces positive results for sterols obtained from ox blood, powdered rye spur, and the grey matter of the human brain. This same treatment also intensifies the action due to the sterols from cod-liver oil and yeast. Similar results are obtained after activation by ultra-violet radiation. In all the above cases the photographic plate was in contact with the material, but on removing the plate to distances up to 6 cm. only cod-liver oil sterols gave any action. Further, the photochemical activity is accelerated and intensified by heating, and by the presence of an oxidising agent. This photoactivity is apparently due to a chemical reaction, as the sterols after illumination become yellow and give off a heavy volatile product, which reduces ammoniacal silver nitrate and gives a rose colour to Schiff's reagent, indicating the presence of an aldehyde. The presence of active oxygen is also shown by Kingzeff's method, and it appears that during insolation or irradiation certain sterols give rise to ozonides. R. C. F.

144. Photoelectric Photometry with Variable Source of Radiation. T. D. Gheorghiu. *Comptes Rendus*, 188. *pp.* 1609–1611, *June* 17, 1929.

A pencil of rays from a mercury vapour arc is rendered monochromatic, and then divided into two by a semi-transparent plate. Each pencil acts on a photoelectric cell (C_1, C_2) producing currents which are compensated by very steady currents measured on potentiometers (P_1, P_2). The compensating current for one cell (C_2) is fixed, and any required photometric measurements are made with the other cell (C_1), observations being only taken when the potentiometer P_2 shows that the current produced by C_2 has its initial value, this obviously being possible only when the radiation from the arc also has its initial value. The arrangement used is shown in detail, and has been satisfactorily tested by its employment to verify Beer's law for a solution of azobenzene. C. A. S.

145. Measurement of Luminescent Light. J. Plotnikow. *Zeits. f. Elektrochem.* 35. *pp.* 432–434, *July*, 1929.

A method based on the polarisation colorimeter of Kruss. J. E.

146. Noteworthy Case of Photoluminescence of Liquids. S. J. Wawilow and L. A. Tummermann. *Zeits. f. Physik*, 54. 3–4. *pp.* 270–276, 1929.

The irradiation or transmission of long-wave ultra-violet radiation creates a blue luminescence in many colourless liquids. In all cases of the same source or type of exciting radiation, the spectra of the luminescence is very similar, but the intensity is very different. The phenomena accompanying this fluorescence, its polarisation and its coloration, etc., are described for different wave-lengths in the exciting radiation. The possible causes of the fluorescence are discussed, and the conclusion is drawn that the continuous spectrum observed by Venkateswaran, caused by the scattering of light in glycerin, can be made to describe the known fluorescence now observed. Water, sulphuric acid, ether, acetone, benzol, toluol, xylol, various alcohols, glycerin, and a large number of other liquids were examined. S. G. B.

147. Polarisation of Thallium Fluorescence. R. Gülke. *Zeits. f. Physik*, 56. 7–8. *pp.* 524–533, 1929.

Excitation with linearly polarised light of the line 2768 Å. gives also the line 3530 Å. both from the same level $3d_2$. In conformity with the theory of Heisenberg [see Abstract 1358 (1925)] the two lines are polarised at right angles to each other, 2768 parallel to the exciting light. The amount of polarisation rises with pressure and approaches the theoretical value as was found with sodium by Datta and with mercury by W. Schütz and v. Keussler. [See Abstracts 1030 (1926) and 2285 (1927).] J. E.

148. Duration of Fluorescence of Uranyl Salts and their Solutions. R. Delorme and F. Perrin. *J. de Physique et le Radium*, 10. *pp.* 177–186, *May*, 1929.

The durable fluorescence of Uranyl salts and their solutions excited by blue light is observed and measured by a modification of the phosphoroscope of Becquerel. The modification consists of the addition of a photometric device of the rotating sector type by means of which the fluorescent light is compared with a controllable fraction of the illumination. It is found that the fluorescence decays according to the law $I = I_0 . e^{-t/\tau}$, where τ represents the mean life of the excited molecules. τ was determined at the temperature of liquid air and at ordinary temperature for the solid salts and for solutions in sulphuric and metaphosphoric acids, and is of the order 10^{-4} sec. The results confirm the hypothesis that the fluorescence is due to the spontaneous deactivation of an activated UO_2 radicle, which is metastable. J. E.

149. Time Lags in Fluorescence and in the Kerr and Faraday Effects. E. Gaviola. *Phys. Rev.* 33. *pp.* 1023–1034, *June,* 1929.

A critical study of the experimental literature is made in regard to time lags or " dark lines " in the fluorescence, and it is found that not a single experiment shows the existence of such things. Experiment seems to show that in all cases where the emitting state is reached directly as a result of excitation, emission begins immediately on excitation and decreases exponentially. There is, however, no experimental evidence for the existence of time lags in the Kerr and Faraday effects. An analysis of the working of the Berné optical shutter indicate the existence of a misunderstanding about it, and that wave losses which were supposed to be cut off by it in 3-cm. lengths are in reality not less than 300 cm. in length. J. E.

150. Some Relations between Chemical Constitution, Absorption and Fluorescence of the Alkaloids. A. Andant. *Comptes Rendus,* 189. *pp.* 98–100, *July* 8, 1929.

From a spectral and spectro-photometric study of the fluorescence and absorption of the alkaloids, general relations are deduced between the constitution and the fluorescence: (1) Isomers have identical or very similar fluorescence. (2) Substitution of CH_3 or $O.CH_3$ intensifies the fluorescence and displaces the maximum towards the red. (3) Etherification of the phenol part produces the same effect. (4) The intensity of the alkaloid salts is stronger than the bases through the shifting of the ultraviolet bands into the visible region. (5) Ultra-absorption requires ultraviolet excitation of very short wave-length. (6) The fluorescence changes little in distribution with different exciting wave-lengths, but increases in intensity as the absorption band is approached. J. E.

151. Fluorescence and Infra-Red Absorption. V. Posejpal. *Comptes Rendus,* 189. *pp.* 159–161, *July* 22, 1929.

The theory of an effect similar to the Raman effect is outlined in which infra-red absorption bands can be predicted from a knowledge of the fluorescence spectrum. The theory is applied to the fluorescence bands of benzene. Among the bands calculated are two which closely correspond with those given by Haber and Lindemann respectively. F. S.

152. A Geometrical Radiation Problem. J. W. T. Walsh. *Phil. Mag.* 7. *pp.* 1092–1093, *June,* 1929. *Supplement.*

The problem of the radiation reaching one circular disc from another, as solved by E. A. Milne [see Abstract 2170 (1929)], was one of those treated by J. H. Lambert in his *Photometria sive de mensura et gradibus luminis, colorum et umbræ* (1760). A simple proof is given of the fact stated by Milne that when the discs are of equal radius the radiation reaching one disc from another is less than that which would reach it from an infinitely large disc in the ratio $\tan^2 \frac{1}{2}\theta$. Parallelism of the discs is not necessary. T. B.

153. Uniformly Diffused Light through Two Apertures. J. W. T. Walsh *Phil. Mag.* 7. *pp.* 1093–1094, *June,* 1929. *Supplement.*

Referring to A. Gershun's analytical solution of the above problem [see

Abstract 2171 (1929)] it is observed that, to 1 %, each of the five sides of the cube of side *l* receives $1/5\pi l^3 B$ of the total flux from the sixth side, B being the brightness of the side admitting the flux. The problem is of considerable practical importance in illuminating engineering. T. B.

154. Amount of Uniformly Diffused Light that will Pass through Two Apertures in Series. P. Clausing. *Phil. Mag.* 8. *pp.* 126–127, *July,* 1929.

The author made some calculations some time ago on the stationary flow of very rarefied gases through capillary tubes, and points out that these calculations are based on the validity of the "cosine-law" for the reflexion of the gas molecules by the walls of the tube. This law is essentially the same as Lambert's law in optics. Referring then to L. F. Richardson's calculation of the amount of uniformly diffused light that will go in series through two apertures forming opposite faces of a cube [see Abstract 804 (1929)] it is shown that the same result may be obtained in a much more general form by direct integration of the general integral used by Richardson, $F = \iiiint(\cos \zeta_1 . dA_1 . \cos \zeta_2 . dA_2)/r^2$. T. B.

155. Temperature of Radiation. R. A. Houstoun. *Phil. Mag.* 7. *pp.* 1139–1143, *June,* 1929.

Tests were made by observing the photographic action to find whether the ability of a radiation to ionise a molecule or atom depended on its temperature. The results of the experiments were wholly negative. J. J. S.

156. Intensity and Composition of the Radiation from the Mass Radiator ("Massenstrahler"). A. Glagolewa-Arkadiewa. *Zeits. f. Physik,* 55. 3–4. *pp.* 234–251, 1929.

A vertical wheel rotates with its lower part in a stirred mixture of oil and metal filings, and sparks are sent into the oily mixture carried up to the top of the wheel. The energy radiated from different portions of the mixture between the two discharge wires is measured by means of a system of mirrors which concentrate it on a thermopile. The points where the sparks enter the mixture on either side of the rim of the wheel give out the greatest amount of energy, which includes some light, but the dark portion between them also radiates energy. The energy is shown to be due to short electromagnetic waves, for the dark part 171, 340 and 957 μ, and also 143 μ, the characteristic wave-length for the spots where the sparks enter the mass. Similar results have been obtained independently by H. Schardin. H. N. A.

157. Doppler Effect and the Hypothesis of Radiation Quanta. D. S. Kothari. *Phil. Mag.* 8. *pp.* 55–63, *July,* 1929.

Dealing first with the Doppler effect for normal incidence on a mirror moving along its normal, an equation is obtained for the Compton effect, so for radiation quanta the Compton effect is really the Doppler effect for a body at rest, or the Doppler effect is the Compton effect for a body in motion. Equations are also obtained for the Doppler effect using radiation quanta for the motion of the source or observer, and for a rotating source, and applied to electronic motions. It is further shown that the constancy of the velocity of light holds whether light is considered as a propagation of waves or quanta. R. S. R.

158. Absorption Spectra of Halogens and Inter-Halogen Compounds in Carbon Tetrachloride Solution. A. E. Gillam and R. A. Morton. *Roy. Soc., Proc.* 124. *pp.* 604–616, *July* 1, 1929.

The absorption spectra of chlorine, bromine and iodine in CCl_4 have been studied. It is shown that iodine chloride, iodine bromide and bromine chloride possess absorption bands, the maxima of which are accurately measurable. At the dilutions necessary for the investigation of absorption spectra all three compounds are dissociated to some extent; with iodine chloride the dissociation is barely detectable, with iodine bromide it remains small, whilst with bromine chloride it is much greater, but still remains probably less than 50 %. Solutions containing halogens in the proportions necessary for the formation of iodine trichloride, iodine tribromide and bromine trichloride were found to contain the monohalide and free halogen only. AUTHORS.

159. Absorption Spectra of Bromine and Iodine. P. Bovis. *J. de Physique et le Radium,* 10, *pp.* 267–272, *July,* 1929.

On examining the results of all the observations of the absorption of light by various substances it is found that many of these are by no means what might be expected according to current theories. The preparation of suitable specimens is described in detail, both for use at ordinary temperatures and also for examining the objects when heated. Observations of the spectra of the two substances were made both in the visible range and in the ultra-violet, and the results obtained are shown graphically: for iodine in the solid state, and for bromine, both as a liquid and in solution in water, carbon disulphide, carbon tetrachloride, ethyl alcohol and chloroform. The results of temperature change upon liquid bromine were also determined, and comparisons are made between the absorption spectra of that substance in the liquid and in the gaseous states. J. G. H. B.

160. Absorption Spectrum of Hydrogen Chloride. C. F. Meyer and A. A. Levin. *Phys. Rev.* 34, *pp.* 44–52, *July* 1, 1929.

The fundamental band and the harmonic band of hydrogen chloride have been measured with narrow slits. The lines of the fundamental, as previously measured, have been resolved, each into two lines arising from the existence of the isotopes Cl_{35} and Cl_{37}. The relative intensities of the lines in the two series are in accord with the accepted ratio for the abundance of the isotopes. In the harmonic, a slight separation of the lines arising from the isotopes had been previously achieved by Randall and Imes. In the present work the degree of separation is greatly enhanced. Wave-number and intensity determinations for the two series of lines in each band are submitted. Figures are given representing the bands in the new form. The ratio of the intensities of the fundamental and harmonic bands, as experimentally determined, is found to be in good agreement with the computed value. AUTHORS.

161. Analysis of HCl Bands. W. F. Colby. *Phys. Rev.* 34. *pp.* 53–56, *July* 1, 1929.

Wave-numbers for the two isotopes of hydrogen chloride in the bands at $3 \cdot 5\,\mu$ and $1 \cdot 76\,\mu$ have been fitted to formulæ cubic in the rotational quantum number. From these formulæ the constants of the molecule have been determined in accordance with the energy expression for the rotating dipole as derived by means of wave mechanics. [See preceding Abstract.] AUTHOR.

162. Absorption Spectra of Several Alkali-Halide Compounds at High Temperatures. Magdalene Forró. *Zeits. f. Physik,* 56. 7–8. *pp.* 534–543, 1929.

The absorption constants at different wave-lengths have been measured at different temperatures for natural NaCl and synthetic NaCl, KCl and KBr. The effect of the addition of small amounts of Tl, Pb and Ag was also measured, and their effect on the absorption at different temperatures is discussed. R. S. R.

163. Infra-Red Spectra. R. Robertson. *Nature,* 123. *pp.* 915–918, *June* 15, 1929.

An account of a lecture at the Royal Institution. Various experiments were shown, including the mapping of an absorption band in ammonia by means of a thermopile and a Moll galvanometer. Oscillation and rotation bands were discussed in the light of the quantum theory, and the results applied in considering the probable structure and the dimensions of molecules. The study of infra-red spectra will undoubtedly be employed more and more in future for determining the nature of chemical linkages and of chemical constitution. Attention was called to the fact that comparatively little work is at present being done in this important field in Great Britain. H. N. A.

164. Near Infra-Red Absorption Spectra of Calcite and Strontianite. E. K. Plyler. *Phys. Rev.* 33. *pp.* 948–951, *June,* 1929.

A study of the near infra-red absorption spectra of calcite and strontianite has been made by using thick specimens. With a specimen 2 cm. thick, cut at right angles to the optic axis, bands were observed for calcite at $1 \cdot 76\,\mu$, $1 \cdot 90\,\mu$, $2 \cdot 00\,\mu$ and $2 \cdot 20\,\mu$. These bands have the same characteristics as those observed by Schaefer, Bermuth and Matossi in the near infra-red. The second order equations have been applied to the bands observed in this work and to those observed by Schaefer, and it was found that series relationships existed between them with only small deviations of the observed from the calculated values. In strontianite a similar set of bands was observed at $1 \cdot 89\,\mu$, $2 \cdot 01\,\mu$ and $2 \cdot 19\,\mu$, and they were of the same type as those for calcite. The value of the inactive fundamental was calculated and found to correspond to a band at $9 \cdot 2\,\mu$, which is in good agreement with the value of $8 \cdot 98\,\mu$ found theoretically by Nielsen [see Abstract 1198 (1929)]. AUTHOR.

165. Combination Bands in the Infra-Red Spectra of CCl_4 and $SiCl_4$. H. H. Marvin. *Phys. Rev.* 33. *pp.* 952–953, *June,* 1929.

It is assumed that the six Raman bands of CCl_4 found by Pringsheim and Rosen give the fundamental absorption frequencies. Simple combinations of these frequencies by addition account for all of the absorption bands between $1\,\mu$ and $16\,\mu$, except a few very weak bands. The absorption bands of $SiCl_4$ in the same region are accounted for by similar combinations of six fundamental frequencies, four of which are known either as Raman bands or as resonance frequencies in the dispersion formula. The two systems of fundamental frequencies and their combinations are strikingly similar, as one might expect in consequence of the chemical similarity of the compounds. AUTHOR.

166. Infra-Red Emission Bands. M. Neunhoeffer. *Ann. d. Physik,* 2. 3. *pp.* 334–349, *July* 15, 1929.

Examines the infra-red emission bands of hydrogen and carbon monoxide flames by means of an accurate reflection grating of high dispersive power and a thermo-junction, accurate intensity curves being given for the principal bands. It is found that only carbon dioxide bands are emitted by the carbon monoxide flame. Further, no solution for individual rotational frequency can be obtained from results for carbon dioxide bands, although with the same dispersion a result for this rotational frequency can be obtained for water vapour from the hydrogen bands. The effects on the spectral intensity distribution by previously heating the air necessary for combustion, and by mixing inert gases with hydrogen or carbon monoxide, are also examined. The intensity curves are found to remain similar in shape, although the intensity values are slightly increased by previous heating and considerably reduced by addition of inert gases. R. C. F.

167. Effect of Temperature on Infra-Red Absorption Bands of Fused Quartz. W. A. Parlin. *Phys. Rev.* 34. *pp.* 81–91, *July* 1, 1929.

The absorption bands of specimens of fused quartz, ranging in thickness from 2·0 mm. for the 3 μ region, to 4×10^{-4} mm. for the 8 μ region, were studied. In regions where sufficient energy was available, an echelette grating was used to give greater dispersion. Measurements were taken at room-temperature and at 850° C. In accord with previous work, the absorption band in the region of anomalous dispersion at 9 μ was found to shift toward longer wave-lengths with increasing temperature. With higher resolution, however, fine structure bands were found which did not shift with the temperature, but did undergo marked changes in intensity. Several sharp bands between 2 and 4 μ were found to remain fixed as the temperature was changed. A broad band which proved to be double was found at 12·5 μ. These bands did not shift with temperature. In most cases there was a marked change in intensity with temperature. It was found that inside the strong bands the absorption was much less at high temperatures, while outside the bands the reverse was the case.

AUTHOR.

168. Rotational Structure of the Red Bands of Sodium. W. R. Fredrickson. *Phys. Rev.* 34. *pp.* 207–212, *July* 15, 1929.

Three bands of the red band system of sodium photographed at high dispersion have been measured. Two strong series of lines run through the bands, and from the combination relations it is quite certain that these series are *bona fide* P and R branches. From the combination relations we find $B_0'' = 0{\cdot}15435$, $D_0'' = -5{\cdot}89 \times 10^{-7}$ and $B_0' = 0{\cdot}10846$. The final state values are in close agreement with those of the final state of the blue-green system, and the constant for the upper state yields $I_0' = 255{\cdot}3 \times 10^{-40}$ gm. cm.^{2} and $r_0' = 3{\cdot}52 \times 10^{-8}$ cm. Search is made for other branches, but none are found. From a discussion of the possible electronic transitions it is concluded that the electronic transition is the $^1S - {}^1S$ type. AUTHOR.

169. Absorption Bands of Solids. F. Urbach. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 5–6. *pp.* 389–418, 1929.

A theory of band-forms. After a discussion as to the paleness of the absorption-bands of solid substances, one of these is carefully considered. An atom oscillating harmonically with its surroundings is assumed; its energy-levels are taken as functions of the positions. The absorption curves on this model are worked out. For a first approximation a Maxwell curve is used for the band-form, the dependence of the band-position on the temperature, and, where this applies, the $\sqrt{T}$ law for the band-breadth. The second approximation gives a shift of the band with the temperature, and a certain departure from the $\sqrt{T}$ law. The conclusion is reached that the band-breadth can never increase more rapidly than according to the $\sqrt{T}$ law. The experimental data agree well with this theory. A. D.

170. Structure of High-Pressure Carbon Bands and Swan System. R. C. Johnson and R. K. Asundi. *Roy. Soc., Proc.* 124. *pp.* 668–688, *July* 1, 1929.

The conditions of production of the high-pressure carbon system and the Swan system are discussed. Both these systems are due to a C_2 molecule. Four new H.P. bands have been found in the near ultra-violet, and two more in the near infra-red. These, with the known bands, form a single vibrational progression ($n' = 0$), and the high-pressure and Swan systems are found both to represent transitions to a common final state. The fine-structure of the high-presure bands (0, 4), (0, 5), (0, 8) and (0, 9) has been investigated. The bands consist of P and R branches only, and the electronic transition involved is ${}^3P^D_n \rightarrow {}^3P^P_i$. Detailed examination of the structure of the R branches of these bands has revealed several anomalies and perturbations of an unusual type. The methods employed by Hund and Mulliken for the elucidation of molecular structure are summarised, and Mulliken's application to the C_2 molecule has been extended to cover the initial state of the high-pressure system. This is believed to be a *normal* ${}^3P$ level and different in this respect from the two lower ${}^3P$ levels, which are believed to be inverted. AUTHORS.

171. Action of Ultra-Violet Light and X-Rays on the Spectrum of Pure and Activated Ergosterol. R. R. Morrison and L. H. Clark. *Brit. J. of Radiology*, 2. *pp.* 307–314, *June*, 1929.

The experiments described indicate a complex change in the absorption spectrum of an alcoholic solution of ergosterol when irradiated with ultra-violet light in a nitrogen atmosphere. The changes on increasing exposure in an oxygen atmosphere are also examined, as well as the spectra of irradiated ergostrol subsequently dried in air. The spectrum of activated ergosterol showed no change as a result of irradiating the material with X-rays. W. V. M.

172. Absorption by the Carboxyl Group of Ultra-Violet Light of Short Wave-Length. H. Ley and B. Arends. *Zeits. f. phys. Chem.* 4. *Abt. B.* 3. *pp.* 234–238, *July*, 1929.

In short-waved ultra-violet light acetic acid shows at 204 mμ a distinct absorption band, probably attributable to the carboxyl group, a second far more intense band probably occurring with shorter waves; the same maximum is exhibited by esters of acetic acid. The spectrum of the heteropolar sodium acetate differs essentially from that of the acid, but further measurements are necessary to indicate if this difference is due to a deep-seated alteration of the chromophore. T. H. P.

173. Spectra of Phosphorus and Arsenic in the Extreme Ultra-Violet. P. Queney. *Comptes Rendus*, 189. *pp.* 158–159, *July* 22, 1929.

An electrodeless discharge in rarefied vapour was photographed with a vacuum grating spectrograph. For phosphorus the region was 2700 to 1200 Å., and for arsenic 2500 to 700 Å., about 350 lines being found in each spectrum. A study of the latter has led to the identification of a number of multiplets of AsIV and AsV, which are tabulated. F. S.

174. Arc Spectrum of Platinum. J. J. Livingood. *Phys. Rev.* 34. *pp.* 185–198, *July* 15, 1929.

Eight new levels and forty-four new combinations have been found in PtI. Fifty-six new lines have been measured in the ultra-violet. An examination of the Zeeman effect and the subsequent determination of the *g*-values for most of the terms has permitted a reasonable interpretation of many levels. Low structures are d^9s, d^8s^2 and d^{10}; middle terms arise from d^9p and d^8sp; high configurations are $d^9 . s$, $d^8s . s$, with an indication of $d^8s . d$. Quintet terms appear in the middle and high sets. From the failure of the intensity and interval rules and the irregularity of the *g*-values, it is evident that the Russell-Saunders coupling has almost completely broken down, as is to be expected from the position of platinum in the periodic table. There is only an approximate similarity with the theoretically analogous spectrum of NiI. Ionisation potentials are approximately calculated as 8·9 volts for d^9s to d^9 and 9·7 volts for d^9s to d^8s.

AUTHOR.

175. New Spectrum of Gaseous Alkali Halides and its Interpretation. K. Sommermeyer. *Zeits. f. Physik,* 56. 7–8. *pp.* 548–562, 1929.

Particulars are given of the spectra of a number of alkali halides. It is considered that the new spectra arise with the transition from the normal to the lowest excitation state of the electronic system of the molecule, and in that state of excitation they are attached essentially, by the forces of polarisation. From the spectrum data the work of dissociation and the values of a large number of basic oscillation quanta can be calculated for the normal atom. The values of these basic oscillation quanta are compared with those calculated by Reis, Born and Heisenberg, and Unsöld and Brück. The agreement of calculated and observed numbers bears out the assumptions in these statements and their use in the calculation of the work of separation for the rotation processes in the ions of the alkali halides, while it also confirms the classification of the alkali halides as ionic molecules.

R. S. R.

176. Notation for Atomic Spectra. H. N. Russell, A. G. Shenstone and L. A. Turner. *Phys. Rev.* 33. *pp.* 900–906, *June,* 1929.

A report is given of a discussion held with a view to the clarification of spectroscopic notation.

F. J. W.

177. Spectroscopic Observations of the Low-Voltage Nitrogen Arc. H. Hamada. *Tohoku Univ., Sci. Reports,* 18. *pp.* 155–164, *June,* 1929. *In English.*

The distribution of spectra in all parts of the low-voltage nitrogen arc was investigated under various conditions of excitation, an ordinary hot-kathode tube of two electrodes being used. The forms of the glow differ in some respects according to the distance between the electrodes, and it was convenient to distinguish three forms of glow: (1) when the distance is short, the glow appears with a nearly uniform luminosity between the electrodes; (2) when this distance is moderate, the positive column and the negative glow corresponding to that in the usual type of Geissler's tube were quite visible separately; (3) at great distance, the positive column breaks into two or more striations, and the lowest voltage forming two striations was 54 volts. The results of the observations are discussed and accounted for throughout. From the intensity distribution of the negative band system, it seems that the more probable the transition from the initial states at which the molecule has the greater vibrational quantum number, the greater is the voltage between the two electrodes. AUTHOR.

178. Spectrum of Ionised Nitrogen (NII). L. J. Freeman. *Roy. Soc., Proc.* 124. *pp.* 654–667, *July* 1, 1929.

In further investigating the spectrum of ionised nitrogen, nine terms belonging to a quintet system have been identified and two new terms of the triplet system. Some seventy-five lines have been newly classified. AUTHOR.

179. Peculiar Hydrogen Bands. C. J. Brasefield. *Phys. Rev.* 33. *pp.* 925–931, *June*, 1929.

Photographs of the secondary spectrum of hydrogen as excited by an electrodeless ring discharge were taken at various pressures in the range 0·08 to 0·001 mm. A number of lines were found to be much more intense at low pressures than at high pressures. The more prominent of these were arranged into a band with P, Q and R branches corresponding to a $\Pi \rightarrow \Sigma$ type electronic transition; this band was assumed to be a $0 \rightarrow 0$ band. The majority of the remaining lines were tentatively arranged into three more bands which appeared to be the $1 \rightarrow 0$, $0 \rightarrow 1$ and $1 \rightarrow 1$ bands corresponding to the same $\Pi \rightarrow \Sigma$ electronic transition. The values of the moments of inertia are $I_0' = 3{\cdot}8 \times 10^{-40}$, $I_1' = 5{\cdot}5 \times 10^{-40}$, $I_0'' = 2{\cdot}0 \times 10^{-40}$ and $I_1'' = 2{\cdot}3 \times 10^{-40}$. The corresponding values of the nuclear separation "r" are $r_0' = 2{\cdot}14 \times 10^{-8}$ cm., $r_1' = 2{\cdot}57 \times 10^{-8}$ cm., $r_0'' = 1{\cdot}55 \times 10^{-8}$ cm., and $r_1'' = 1{\cdot}66 \times 10^{-8}$ cm. The emitter of these bands is thought to be either H_2^+ or doubly excited hydrogen. AUTHOR.

180. Continuous Spectrum of Hydrogen. D. Chalonge and N. T. Zé. *Comptes Rendus*, 189. *pp.* 243–245, *July* 29, 1929.

On passing condensed sparks (from aluminium electrodes) of increasing intensity through hydrogen under conditions otherwise similar to those previously described [see Abstract 2742 (1929)] the intensity-wave-length curve is at first substantially unchanged, the intensity of the Balmer series merely increasing; but after a certain capacity has been reached the appearance and the curve suddenly change, due probably to the superposition of the continuous atomic on the molecular spectrum, the latter becoming weaker. The maximum intensity of the atomic spectrum occurs well before the limit of the Balmer series, and is displaced more and more towards greater wave-lengths, this being accompanied by progressive widening of the lines of the Balmer series (due to the Stark effect), and a diminution in the number of lines visible. C. A. S.

181. New Infra-Red Spectra of Helium and Mercury. T. Takamine and T. Suga. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 198. *pp.* 131–137, *July* 24, 1929. *In English.*

Using a Geissler tube excited by a heavy current, the near infra-red spectra of helium and mercury have been photographed, employing the heating of an "infra-red sensitive" plate hypersensitised with ammonia and also by phosphoro-photography. The band spectrum of helium in the near infra-red is only approximately analysed, as the dispersion used is too small to give accurate results. It is possible to obtain a phosphorophotogram of the $1 \cdot 080\,\mu$ helium line with only four minutes' exposure. A group of mercury lines in the region $0 \cdot 7\,\mu$ and $1 \cdot 0\,\mu$ are obtained, as well as the known mercury lines, whilst the advantage of heating is emphasised from the fact that only an exposure of one hour is necessary with the heated plate, compared with fifteen hours' exposure when a plate at normal temperature is used. Two oxygen lines, $\lambda 0 \cdot 846\,\mu$ and $\lambda 0 \cdot 777\,\mu$, appearing as impurities, are obtained with remarkable intensity, and these may be of astrophysical interest. R. C. F.

182. Helium Band Spectrum. Part III. S. Imanishi. *Inst. Phys. and Chem. Research, Tokyo, Sci. Papers, No.* 199. *pp.* 139–149, *July* 27, 1929. *In English.*

New measurements of the higher members of the helium $2^3\,\sigma\Sigma - m^3\pi\Pi$ series bands in the ultra-violet have been made in the 2nd order of a 15-ft. concave grating. Two new bands, $2^3\sigma\Sigma' - 8^3\pi\Pi'$ and $2^3\sigma\Sigma' - 9^3\pi\Pi'$, have been found and are analysed. Constants are calculated for these bands, and a Rydberg formula is suggested which expresses the electronic frequencies accurately. [See also Abstract 3042 (1929).] F. S.

183. Intensity Measurements on Multiplets of Mercury and Neon Excited by Electron Impacts. W. Ende. *Zeits. f. Physik,* 56. 7–8. *pp.* 503–515, 1929.

With a tube constructed on the lines of the Hertz tube [see Abstract 1457 (1924)] triplets of mercury and the red and green groups of neon have been excited by bombardment with electrons of known velocity. The photometric method of Dorgelo [see Abstract 1360 (1925)] was used to investigate the intensity distribution. The intensity ratio of the mercury triplets $2^3P - 2^3S_1$ was 60 : 100 : 49, and from 12 to 40 volts was independent of the speed of the electrons. Nor was there any alteration with increase of current density from 0·1 to 23 mA. No simple explanation of the intensity ratio seems possible at present, and there appear to be no simple regularities. J. E.

184. Mean Life for the Mercury Spark Spectrum. L. R. Maxwell. *Phys. Rev.* 34. *pp.* 199–206, *July* 15, 1929.

By using the method previously described by the writer [see Abstract 1181 (1929)] for measuring the average life of excited ions, a mean life of 9×10^{-7} and 8×10^{-7} second was found for the 3114 and 2572 lines, respectively, of Hg IV, 6×10^{-7}, 4×10^{-7} and 4×10^{-7} second for the 3090, 3312 and 4797 lines, respectively, of Hg III. The prominent lines of Hg II are estimated to have a mean life of the order of 10^{-8} second. These results indicate that the greater the charge of the ion producing the line the longer the mean life. The formula derived for determining the mean life is discussed, and experimental results are given which agree quite satisfactorily with the theory developed for measuring the mean life Intensity-current relations of the spark lines show that they are produced as the result of single electron collisions, which substantiates the assumptions made in the above theory. It is pointed out that lines due to electrons jumping from the same energy level should have the same mean life regardless of the level to which the electrons may jump. The above lines have not been classified, so a correlation between the electron transitions and mean lives cannot at present be made. AUTHOR.

185. Simultaneous Ionisation and Dissociation of Oxygen and Intensities of the Ultra-Violet O_2^+ Bands. E. C. G. Stueckelberg. *Phys. Rev.* 34. *pp.* 65–67, *July* 1, 1929.

Observations by Hogness and Lunn, Smyth and Stueckelberg, showing that O^+ is formed from the neutral molecule by a single impact of about 20 volts, are explained from the potential energy curves of the molecule and ion. These have been obtained from a method given by P. M. Morse, and from the empirical law $r_0^3\omega_0 = 3000$ Å. cm.$^{-1}$. The intensities of the ultra-violet O_2^+ bands have been calculated from the same curves and are in good agreement with experiment. AUTHOR.

186. Arc Spectra in the Region λ1600-2100. E. W. H. Selwyn. *Phys. Soc., Proc.* 41. *pp.* 392–403; *Disc.*, 403, *June*, 1929.

A simple method is described of photographing ordinary arc spectra down to about λ1600, and measures are given of the spectra thus observed between λ1600 and λ2100 of thirteen elements. The measures are believed to be of an accuracy sufficient to make them useful as provisional standards of wave-length. A number of lines hitherto unobserved is recorded, and additions have been made to the analysis of the spectra of Mg I, Be 1 and B 1. AUTHOR.

187. Second Spark Spectrum of Sulphur (SIII). S. B. Ingram. *Phys. Rev.* 33. *pp.* 907–913, *June*, 1929.

With experimental data previously obtained the spectrum of sulphur III is analysed. Most of the triplet terms predicted by the Hund theory are found and the strongest lines in both the visible and extreme ultra-violet regions are classified. The ground term $3s^2 3p^2\ {}^3P_0$ gives the ionisation potential as 34·9 ± 0·4 volts. Complete term tables and a list of classified lines are given. The term $3s^2 3p.4s\,{}^3P$ is anomalous, having a total separation of 450, while the *p* doublet of the ion is 950. The interval ratio of this term is 10 to 1, instead of the 2 to 1 given by Landé's rule. Combinations of this term with the ground term in the extreme ultra-violet are unusually weak. [See also Abstract 171 (1929).] AUTHOR.

188. First Spectrum of Krypton. W. F. Meggers, T. L. de Bruin and C. J. Humphreys. *Bureau of Standards, J. of Research*, 3. *pp.* 129–162, *July*, 1929.

The older data on the first spectrum of krypton being inadequate for an analysis, discharge tubes were prepared with krypton gas of high purity and operated to emit the spectrum of neutral Kr atoms. About 200 lines (3302·54 to 9751·77 Å.) characterising the first spectrum of krypton were photographed with concave grating and quartz spectrographs. From these spectrograms a new list of estimated intensities and measured wave-lengths was obtained. Analysis of these new data led to the identification of the main spectral terms analogous to those of the similarly constructed neon and argon spectra. Practically all of the KrI lines have been classified in series of various types. From the combinations and series limits absolute term values are derived, and the ionisation potential of 13·940 volts is deduced for Kr. The general features of the KrI spectrum are found to be closely analogous to those of the preceding rare gases NeI and AI, and in excellent accord with the theoretical expectations. The proposal that the krypton line 5649·56 Å. be substituted for the cadmium line 6438·4696 Å. as a primary standard of wave-length is discussed. The proposed krypton standard has relatively low intensity, and it involves a metastable level. These objections do not apply to the stronger line 5870·92 Å., but it cannot be recommended as a standard until it has been re-examined for hyperfine structure. AUTHORS.

189. Resonance Spectrum of Tellurium. W. Kessel. *Comptes Rendus*, 189. *pp*. 94–96, *July* 8, 1929.

Studies the resonance spectrum of tellurium vapour by means of a spectrograph giving a high dispersion. Fundamental doublets at λ4358 and λ4452 as well as 13 other lines which require closer study are observed. E. E. F. d'A.

190. Simultaneous Ionisation and Excitation of Diatomic Molecules by Impacts with Positive Ions and Excited Atoms. O. S. Duffendack and H. L. Smith. *Phys. Rev*. 34. *pp*. 68–80, *July* 1, 1929.

A study is made of mixtures of helium, neon and argon with carbon monoxide and nitrogen, wherein it is demonstrated that impacts occur between a rare gas ion and a diatomic molecule leading to ionisation and excitation of the latter. It is also shown that impacts of the second kind between excited helium and neon atoms and neutral carbon monoxide molecules, resulting in the simultaneous ionisation and excitation of the latter, are possible. Experiments are described which show the effectiveness of either type of impact to be greatest when the energy difference is the least. Two new bands in the Baldet-Johnson band system due to ionised carbon monoxide with edges at λ4454·95, 4458·94, 4480·24, 4485·00; and 4494·30, 4498·31, 4519·89, 4524·89 are reported, and six new edges and a new band at λ3413·14, 3414·60; 3584·20, 3600·75; 4116·69, 4348·08; 5856·30, 5860·37, 5900·21, 5905·85 in the comet-tail system. An analysis of these two systems is given. From the study of the intensity distribution of the negative band systems of carbon monoxide excited in He-CO and Ne-CO mixtures, the following deductions relating to the degree of excitation of the CO-ion in the two mixtures are made: In Ne-CO mixtures there are many more CO-ions in the 16·8-volt state than in the 20-volt state, but in He-CO mixtures the reverse is true. A study of the intensities of the individual comet-tail bands excited in He-CO and in Ne-CO mixtures under the same conditions shows that the exciting processes in He-CO mixtures are more effective in exciting the higher vibrational states of the comet-tail bands than they are in Ne-CO mixtures. The spectrum of carbon dioxide recently observed and reported by Fox, Duffendack and Barker has been shown to be due to the carbon dioxide ion. H. H. Ho.

191. Spectrum of Trebly-Ionised Thallium. K. R. Rao. *Phys. Soc., Proc*. 41. *pp*. 361–365; *Disc*., 365, *June* 15, 1929.

Using the measurements made by Carroll of the vacuum spark spectrum of thallium, combinations of the triad of triplet and singlet F, D, P terms of the d^9p configuration of TlIV with the deeper ^{3}D and ^{1}D of the d^9s state have been found. Justification of the scheme is sought by comparison with similarly constituted spectra. AUTHOR.

192. Spectra of CuI, CuII and MnII by Means of a Vacuum Tungsten Furnace. O. S. Duffendack and J. G. Black. *Phys. Rev*. 34. *pp*. 35–43, *July* 1, 1929.

A high temperature vacuum tungsten furnace for the study of the spectra of elements having high boiling points is described. All previously observed absorption lines of Cu in the range of the quartz spectrograph were observed and in addition six new lines from the $3d^94s$ level as follows: 2618·381, 2824·375, 2882·81, 2961·177, 3010·840, 3194·103. CuH bands were also observed in absorption. Light from the furnace walls excited Cu atoms to the ^{2}P state with the subsequent emission of 3247, 3274, 5106, 5700, 5782. With the walls somewhat cooler these lines were brought out when the vapour was exposed to intense radiation from the outside. A-Cu mixtures at 25 volts failed to develop the CuII spectrum. From Ne-Cu mixtures at 25 volts the lines from the $3d^95s$ state were much stronger than those from $3d^94p$. Theory shows that in A-Mn, Ne-Mn and He-Mn mixtures the spectrum of MnII should be excited to the extent of 64800, 113400 and 138500 wave-numbers respectively. The strong $(3d^54p)^7$P — $(3d^54d)^7$D multiplet should be excited in Ne-Mn mixtures but not in A-Mn. This was verified experimentally. An analysis, similar to that of Russell, of the MnII spectrum is given. AUTHORS.

193. Spectral Relations between Certain Iso-Electronic Systems and Sequences. Part III. TiI, VII, CrIII, MnIV and FeV. H. E. White. *Phys. Rev.* 33. *pp.* 914–924, *June*, 1929.

The investigation is on similar lines to that for other iso-electronic sequences described in Parts I and II [see Abstract 2951 (1929)]. The new type of energy-level Moseley diagram takes for the present sequence a form almost identical with those obtained for the three iso-electronic sequences starting respectively with ScI, CaI and KI. W. S. S.

194. Raman Effect. A. Dadieu and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 1–2. *pp.* 41–61, 1929. *Phys. Zeits.* 30. *pp.* 384–391, *June* 15, 1929.

The Raman effect has been studied for certain aliphatic substances, *viz.*, the fatty acids and their esters, whilst preliminary data are included for carbon tetrachloride, benzene, toluene, acetone and pentane. The study is extended to aromatic substances and to benzene in particular, 25 organic products having been examined in all. The respective frequencies obtained are discussed with respect to molecular union. In addition to the characteristic frequency $\nu' = 3050$ for the CH- band, the existence of a frequency $\nu' = 2940$, hitherto only found in aliphatic CH- bands, has been established for benzene. Anti-Stokes lines have only been obtained with halogen derivatives. Undisturbed superposition of Raman spectra in mixtures of different substances has been confirmed and employed for observation of dissolved substances (naphthalene in carbon tetrachloride). Frequencies characteristic of dissociation in water were not found. Influence of temperature on intensities of Raman frequencies and on classically scattered (undisplaced) excited lines has been qualitatively determined. [See also following Abstract.] H. H. Ho.

195. Raman Effect. A. Dadieu and K. W. F. Kohlrausch. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 5–6. *pp.* 335–351 *and* 419–429, 1929.

Continues previous work [see preceding Abstract] on Raman spectra of organic substances and in particular deals with benzene derivatives. Their interpretation is investigated, and the conclusion is drawn that at least some of the lines are to be regarded as the manifestation of the oscillations of definite parts of the irradiated molecule with respect to each other. It is shown that this division into internal and external oscillations can be applied to liquid molecules, and thus affords a broad systematisation of Raman spectra. The internal oscillations considered are the aromatic C-H, the aliphatic C-H, the $C = O$, and the NO_2 unions together with the stable benzene frequencies and those for O-H and N-H. The external oscillations dealt with are those of the CH_3, OH, and NH_2 groups. Gaps are also discussed. H. H. Ho.

196. Comparative Study of Raman Spectra for Hydrogen Compounds. Daure. *Comptes Rendus,* 188. *pp.* 1492–1494, *June* 3, 1929.

The author shows that a comparison of Raman spectra can give indications of the molecular constitution of the molecule. For hydrogen compounds with a single bond rays of frequency 278–340 waves per mm. occur, and these are the only rays for the H bonds. For more complex components with C bonds other rays exist. Certain organic components not presenting the double bond have a ray with a frequency 143–146 waves per mm., while the double bond $C = O$ gives a frequency of 166–174 waves per mm. R. S. R.

197. Raman Spectra of Para-, Ortho- and Meta-Xylene. (Miss) W. Czapska. *Comptes Rendus,* 189. *pp.* 32–33, *July* 1, 1929.

The three liquids were illuminated by light from a mercury arc, and the Raman spectra produced by the different mercury lines were photographed and tabulated. They are not identical, but the frequency differences $\Delta\nu = 1373$ and $\Delta\nu = 2918$ occur in the case of all three compounds, and certain frequency differences are common to pairs of the compounds, $\Delta\nu = 1180$ to para and meta, and $\Delta\nu = 723,734$ to meta and ortho. It is clear that the vibrations in the molecule depend on the nature of the intramolecular bonds, which are different in different portions of the molecule. H. N. A.

198. Raman Spectra of Compounds. A. Petrikaln and J. Hochberg. *Zeits. f. phys. Chem.* 4. *Abt. B.* 4. *pp.* 299–311, *July,* 1929.

In this continuation of previous work [see Abstract 3038 (1929)] the Raman spectra of 15 organic and 2 inorganic compounds have been investigated. The compounds were chosen to throw light on the question of chemical structure. Tables of results are given for each compound, and in a *résumé* the constancy of wave-length of infra-red bands corresponding to certain types of chemical binding is brought out. F. S.

199. Theory of the Scattering Problem. F. Sauter. *Ann. d. Physik,* 2. 4. *pp.* 465–476, *July* 26, 1929.

A discussion is given of the general problem of the composition of the radiation in a medium which scatters and absorbs, given the incident radiation and the laws of absorption and scattering. The possibility of change of quality (frequency, velocity, etc.) in the scattering process is contemplated. A complicated integro-differential equation is derived which must be solved for given boundary conditions. Theoretically it is possible to obtain the solution as a convergent series, but in practice certain intractable definite integrals are encountered. W. S. S.

200. Incoherent Scattered Radiation in Diatomic Molecules. F. Rasetti. *Phys. Rev.* 34. *pp.* 367–371, *July* 15, 1929.

Raman spectra excited in diatomic gases by the line $\lambda 2536$ of mercury have been photographed with a quartz spectrograph. An apparatus for using gases at pressures from ten to fifteen atmospheres has been built, with great improvement as compared with the use of gases at atmospheric pressure. Results obtained with H_2, N_2, O_2, NO are reported. A particularly complete investigation has been made of the hydrogen spectrum, leading to an accurate determination of the constants of the molecule in the normal electronic state. The numerical values are (in cm.^{-1}) $B_0 = h/8\pi^2 I_0 c = 59\cdot 40$; $\omega_{0/1} = 4162\cdot 1$. For N_2, the corresponding values resulted to be: $B_0 = 1\cdot 992$; $\omega_{0/1} = 2330\cdot 7$. For O_2: $B_0 = 1\cdot 436$; $\omega_{0/1} = 1554\cdot 7$. All these molecules are in Σ states, and the Raman spectra consist of Q-, double R-, and double P- form branches, as deduced from the Kramers-Heisenberg formula by the author and by Hill and Kemble. Nitric oxide is the only molecule so far investigated which is in a $^2\Pi$ state. The transition between the two terms of the doublet has been observed in the scattered radiation. AUTHOR.

201. Vector Coupling in Nickel-Palladium and Platinum-Like Spectra. J. E. Mack. *Phys. Rev.* 34. *pp.* 17–34, *July* 1, 1929.

The $5d^96s$ and $5d^96p$ configurations have been identified among the known levels of PtI, and partly so in TlIV and PbV. Observations on the condensed spark discharge in thallium and lead are recorded. The study of the relative behaviour of the levels of the sequences NiI–GeV, PdI–SnV and PtI–PbV is based on the work of Goudsmit and Uhlenbeck, who studied the $2p^53s$ and $2p^53p$ configurations of neon. There is a gradual transition from LS to *jj* coupling with increasing atomic number and increasing net charge. The positions of the d^9p groups for HgIII, TlIV and PbV agree with those calculated for *jj* coupling, using the Sommerfeld regular doublet law. In several of these spectra, levels of the same J value cross, when relative energy is plotted against nuclear charge in an electronic sequence. But, in general, correlation of levels and crossing or not crossing, in spectral series or isoelectronic sequences, appear to be without meaning, since neither quantum numbers nor nuclear charges are continuous variables. H. N. A.

202. Effect of Nuclear Spin on Optical Spectra. J. Hargreaves. *Roy. Soc., Proc.* 124. *pp.* 568–591, *July* 1, 1929.

In recent work on the hyperfine structure of optical spectra an explanation of the structure has been found in a nuclear spin. In the present paper (mathematical), the methods of the new quantum mechanics have been applied to the problem of the motion of a single electron in a Coulombian field due to a nucleus possessing half a quantum of spin. Each of the electron-spin fine-structure levels splits into two, and the method gives wrong results for the S levels, but empirical equations are constructed and a new quantum number assigned and a magnetic quantum number fixed. The separation of the electron-spin, fine-structure levels differs from Jackson's estimation by a numerical factor which, in the case of the P levels, is 8/9. [See also Abstract 837 (1929).] G. E. A.

203. Integrating Microphotometer for X-Ray Crystal Reflections. Part II. W. T. Astbury. *Journ. Sci. Instruments*, 6. *pp.* 192–196, *June, and pp.* 209–213, *July*, 1929.

A more detailed description than given previously [see Abstract 2725 (1929)] of the photometer table and its accessories, and of the technique of preparing the carbon tissues for use with the photometer. Several improvements at present being tested are indicated. W. H. GE.

V. 33
1930

204. Spinning Target X-Ray Generator. A. Müller. *Nature*, 124. *p.* 128, *July* 27, 1929.

In many applications of X-rays it would be very valuable to work with higher energy densities than those which have yet been used. This requires a more radical method of removing the heat [see Abstract 661 (1928)]. A simple way of doing this is to produce the focus on the periphery of a rotating disc. By such means the input limit may be raised in accordance with the expression, $W_{mr} = W_{mnr} \times \sqrt{\frac{\delta\rho cv}{k}}$, where W_{mr} and W_{mnr} are the maximum inputs for targets rotating and at rest respectively, c is the specific heat of the antikathode material, k the thermal conductivity, ρ the density, δ the radius of the focus in cm., and v the velocity of the target at the focus. This equation holds only if the expression under the square root is large compared with unity. The use of the rotating disc prevents excessive local heating, but it is still necessary to remove the heat from the kathode as a whole, and this can be done by a water-cooling system. An experimental X-ray plant embodying these principles of design has been built in the Davy–Faraday laboratory. T. H. P.

205. Absolute Measurements of Intensity of X-Rays. O. Gaertner. *Ann. d. Physik*, 2. 1. *pp.* 94–122, *June* 7, 1929.

The intensity of the filtered radiation of a glow kathode tube with copper anode was measured by means of an electrically calibrated thermo-element and compared with the ionisation which this radiation produced in the gases hydrogen, nitrogen (40·8), oxygen (34·4), argon (29·6) and air (36·4). The pressure in the ionisation chamber was (H excepted) so high that the likewise measured unabsorbed portion is a correction magnitude. For argon the measurements were further carried out with the radiation of a molybdenum anode. For 0·714 Å. the result is 29·3 volts per pair of ions. For oxygen an actually higher saturation tension is obtained than for nitrogen. J. J. S.

206. Unusual Reflecting Power of a Pair of Calcite Crystals. B. Davis and H. Purks. *Phys. Rev.* 34. *pp.* 181–184, *July* 15, 1929.

Two split calcite crystals were mounted on a double X-ray spectrometer in parallel position. Coefficient of reflection, percentage reflection and width of rocking curve were measured at first and second orders for three wave-lengths. The width of the rocking curves is less than to be expected from Darwin's equation using previously determined values for the structure factor. These crystals are especially valuable for use on the duo-double crystal spectrometer when high dispersion is desired. J. E.

207. Refraction of X-Rays in Liquids and Solutions. J. A. Prins. *Zeits. f. Physik*, 56. 9–10. *pp.* 617–648, 1929.

The theory of the refraction is consolidated and applied to concrete cases. In some cases it appears that the arrangement of the molecules is entirely a matter of geometrical probability; in others we must consider the inter-molecular forces. Especially, a strong dispersion, short of the maximum, is related to a tendency to association of the molecules. In solutions, especially in ion-solutions, the influence of Coulomb's law upon the refraction was investigated; the results agree well, at least qualitatively, with experiment. Photographic apparatus requiring only short exposures are described. The paper comprises: (1) theoretical, introduction and preliminaries, monatomic molecules, inter-molecular forces, polyatomic molecules, solutions, ion-solutions; (2) experimental, apparatus and general remarks, "spherical" molecules, "dumb-bell-shaped" molecules, "far-stretched" molecules, organic molecules, ion-solutions. A. D.

208. Experimental Investigation of the [Possible] Polarisation of Röntgen Radiation Emitted by a Lilienfeld Röntgen Tube. H. Seemann. *Zeits. f. Physik*, 55. 5–6. *pp*. 371–373, 1929.

Although the focus of a Lilienfeld tube emits almost completely linearly polarised blue light characterised by a continuous spectrum, no polarisation was detected in the Röntgen radiation (Bremsstrahlung) from the tube operated at 100 kV. [See Abstract 846 (1929).] J. S. G. T.

209. Continuous X-Ray Spectrum. C. Eckart. *Phys. Rev.* 34. *pp*. 167–175, *July* 15, 1929.

This paper is entirely mathematical, and under the assumption that the target of an X-ray tube is a plane mirror which completely reflects the electron waves, the characteristics of the continuous X-ray spectrum are deduced from wave-mechanics principles. Various deductions are made, and it is found the intensity has a maximum in the azimuth of the velocity of the incident electron, the normal to the target being the polar axis. For very small velocities the radiation is linearly polarised parallel to the normal of the target, but for higher velocities, whilst the radiation is plane polarised, the polarisation cannot be so simply described. The theory accounts for many of the characteristics of the continuous X-ray spectrum. Where discrepancies occur the schematic model and not the quantum theory is the cause of variation. B. J. L.

210. X-Ray Spectra of Gases. A. Björkeson. *Zeits. f. Physik*, 55. 5–6. *pp*. 327–337, 1929.

X-ray spectra of gases have been excited by the interaction of molecular and electronic rays. Potassium vapour gave the Kα line. From experiments with sulphur in an improved apparatus five lines were photographed and measured. Using copper sulphide as an antikathode, three of these lines were obtained. Although they were much more intense than the corresponding lines from sulphur vapour, no trace was found of the two other sulphur vapour lines. F. J. W.

211. Evidence for Filling of Electron Levels from the Relative Intensity of X-Ray Spectrum Lines. S. K. Allison. *Phys. Rev.* 34. *pp*. 7–16, *July* 1, 1929.

According to the accepted theory of the periodic system electrons first enter the 5_3 orbits at 57 La; only one electron remaining in these orbits until 72 Hf, whence the orbits fill up to 10 electrons at 79 Au. The Lβ_5 line is double, representing the transitions 5_{32}, $5_{33} \rightarrow 2_{22}$. In a previous paper [see Abstract 2735 (1928)] the author found that this line was much more intense (about 37 times for Lβ_5 alone) in the uranium than in the tungsten L series. This paper reports intensity measurements involving this line in 76 Os, 77 Ir, 78 Pt, 79 Au, 81 Tl, 82 Pb, 83 Bi. It is shown that experimental difficulties due to deposition of tungsten on the targets from the filaments may be avoided by keeping high vacua in the tubes. A curve showing the intensity ratio β_5/β_1 as a function of the atomic number rises with increasing atomic number and takes an upward jump between 78 Pt and 79 Au. This indicates that the first element in which 10 electrons occupy the 5_3 orbits in an approximately undisturbed condition in the solid state is 79 Au. The curve is similar to one obtained in the region about 46 Pd for the lines Lγ_1 and Lβ_2 by Jönsson. AUTHOR.

212. Effect of Chemical Combination on Absorption of X-Rays at Wave-Lengths on each Side of the K-Discontinuity. C. L. Cottrell. *Phys. Rev.* 33. *pp.* 879–888, *June*, 1929.

The difference in the absorption of X-rays by iodine in the free state as compared to that of iodine in the chemically combined state was investigated for wave-length bands on each side of the K-absorption limit of this element. The method used was the double ionisation chamber method, with the X-ray bands obtained by voltage control and filters. The results indicate that on the long wave-length side of the K limit the absorption coefficient of the chemically free iodine atom is about 0·3 % greater than that of the combined atom, while on the short wave-length side of the K limit the reverse is indicated, with a difference of about 0·5 %. Silver was also investigated, but from the few measurements obtained the absorption coefficient of the chemically free silver atom, as reduced from AgCl by sunlight, seems to be greater than that of the combined silver atom in the AgCl before reduction for wave-length bands on each side of the K limit of silver. AUTHOR.

213. Multiple Absorption and Secondary K-Absorption Edges in the X-Ray Region. B. B. Ray. *Zeits. f. Physik*, 55. 2. *pp.* 119–126, 1929.

The existence of secondary absorption edges which lie on the short wave-length side of Kossel's fine structure limit is explained by assuming one quantum of incident radiation capable of being absorbed by two electrons in the atom, so that a double change in electron arrangement occurs (*e.g.*, one electron removed from the K shell to the periphery, another from the M shell to the periphery). Computations are made for the secondary K-absorption edges of calcium, potassium and chlorine, and comparison with Nuttall, Lindsay and van Dyke's observations shows close agreement between theory and experiment. A suggestion is made that the observed absence of fine structure to the absorption edges, in the case of pure metals, is due to the fact that the valency electrons are, in effect, free electrons in the metal, and the optical orbits do not exist. W. S. S.

214. Resolution of the Line Lβ_2 into its Diagram Components and the Relative Widths of Some X-Ray Spectrum Lines. S. K. Allison. *Phys. Rev.* 34. *pp.* 176–180, *July* 15, 1929.

The Lβ_2 line should, on atomic constitution principles, be double, *i.e.*, it consists of transitions from the levels $N_{iv} . N_{v} \rightarrow L_{iii}$. The present experiments were made with a double spectrometer with this line for iridium, thallium and uranium. For the first, resolution could not be obtained owing to the great width of the line. For thallium a better, but not complete, resolution was obtained. For uranium complete separation was achieved. B. J. L.

215. M-Series of Rhenium. E. Lindberg. *Zeits. f. Physik*, 56. 5–6. *pp.* 402–404, 1929.

The author, using a high vacuum precision spectrograph and an anode with higher Re content, has been able to measure the wave-lengths of several more lines in the M-series. The results are tabulated. [See also Abstract 185 (1929).] R. S. R.

216. Use of Optical Gratings for X-Ray Analysis in the Region of 1 to 2 A. H. Seemann and K. F. Schotzky. *Zeits. f. Physik*, 55. 3–4. *pp.* 252–272, 1929.

It is found that the extent of interference decreases rapidly with increase in the hardness of the X-rays and the number of lines per mm. of the grating. Spectra were obtained only with a coarse grating of 142 lines per mm. and X-rays of 2·3 Å. It is suggested that the fraction of radiation passing through the grating without refraction increases with increasing hardness of the X-rays and fineness of the grating. F. J. W.

217. Diffraction of X-Rays by a Two-Dimensional Crystal Lattice. W. Linnik. *Zeits. f. Physik*, 55. 7–8. *pp.* 502–506, 1929.

Experiments were made in which crystals were split up into very thin sheets, which were not shifted in position with regard to one another, the lattice lines in all the layers having the same direction. The space lattice is in this way broken up, and if the number of layers is not too large a Laue diagram is obtained, when a narrow X-ray beam is sent through the sheets on to a photographic plate, which is quite different from that obtained with a thick plate of the crystal, and is that of a two-dimensional lattice. Mica can be split up in a suitable manner by heating to red heat; this makes the plate opaque to light. The lattice consists of equilateral triangles, with the sides equal to 5·17 Å. according to Mauguin; the author obtains the value 5·2 Å. In reflected rays the effect is by no means clear. Experiments have also been made with plates of gypsum, rock-salt, and Iceland spar. H. N. A.

218. Diffraction of X-Rays in Liquids: Benzene, Cyclohexane and Certain of their Derivatives. G. W. Stewart. *Phys. Rev.* 33. *pp.* 889–899, *June*, 1929.

The diffraction of X-rays by benzene, toluene, *o*-, *m*- and *p*-xylene, mesitylene, ethyl benzene and isopropyl benzene; cyclohexane, methylcyclohexane, *o*-, *m*- and *p*-dimethyl cyclohexane; phenol, aniline, cyclohexanol and cyclohexanone; 2-hydroxy-1, 3-dimethyl benzene, 2-hydroxy-1, 4-dimethyl benzene, 4-hydroxy-1, 2-dimethyl benzene, and 4-hydroxy-1, 3-dimethyl benzene; *o*-, *m*- and *p*-toluidine, and *o*-, *m*- and *p*-cresyl methyl ether, have been examined. The results show that the benzene and cyclohexane rings are distinctly flat in that they have a thickness of 4·70 Å.U. and 5·10 Å.U. respectively. They have areas of 31·4(Å.U.)^2 and 35·2(Å.U.)^2 respectively, and appear to maintain the same general shape in substituted compounds. The thickness of the rings depends upon the relative positions of the substituents, and appears to be least in para-derivatives. The six hydroxy derivatives gave rise to a characteristic diffraction peak which is supposed to be due to the existence of double molecules formed by the juxtaposition of two hydroxyl groups. Ten of the compounds studied gave also a third diffraction peak which is dependent upon the relative position of the substituent groups rather than their chemical nature. F. J. W.

219. Change of Frequency of X-Rays Scattered by Bound Electrons. D. P. Mitchell. *Phys. Rev.* 33. *pp.* 871–878, *June*, 1929.

This is a report of the detailed investigation which followed the discovery of "fine structure in scattered X-rays" reported in April 1928. Molybdenum Kα_1 X-rays were scattered at about 90° by graphite, aluminium, and beryllium. Lines from graphite were shifted 0·0013, 0·0023 and 0·0113 Å. to the long wave-length side of MoKα_1. From aluminium the shifts were 0·0023, 0·0055 and 0·069 Å. to the long wave side of MoKα_1. From beryllium the shifts were 0·0048 Å. to the long wave-length side and 0·00065 Å. to the short wave-length side of MoKα_1. Graphite shifts for scattering angles of 42° and 147° were the same as for 90°. This and all curve widths establish the fact that the scattering electrons were ejected with zero kinetic energy. Hence the energy relation is $h\nu' = h\nu \pm Ve$. From this the critical potentials are obtained: 32, 57 and 279 volts, for carbon; 57, 136 and 1550 volts, for aluminium; 16 and 119 volts, for beryllium. AUTHOR.

220. Fine Structure in the Compton Effect. B. Davis and H. Purks. *Phys. Rev.* 34. *pp.* 1–5, *July* 1, 1929.

The scattered radiation from graphite and beryllium was studied, using a special X-ray tube with the scattering substance very near the target and so mounted that the scattering angle was large. For carbon with scattering angle 155° the displacements from the strong MoKα line were 0·0421, 0·0012, 0·002 and 0·0109 Å. The displacement is less than to be expected from the formula. For beryllium scattering at 163°, lines were found at 0·0446 Å. from the main MoK line and at 0·0051 Å. on the long-wave side. The latter displacement is near to that to be expected from the BeKα level. Also another line at 0·0009 Å. on the short-wave side was observed. A discussion of the possible mechanism is given. J. E.

221. Compton Scattering and the New Statistics. S. Chandrasekhar. *Roy. Soc., Proc.* 125. *pp.* 231–237, *Aug.* 1, 1929.

The characteristics of the radiation scattered when a beam of monochromatic X-rays is incident on a conductor, are considered. The valency electrons in the conductor are assumed to have a velocity distribution given by the Fermi-Dirac statistics, and Compton's scattering law is applied to each elementary scattering act. The intensity distribution of the scattered radiation as a function of frequency, is evaluated. It appears that the intensity falls off parabolically from its maximum value (which occurs at the place where the Compton relation $\lambda' - \lambda = h(1 - \cos \theta')/mc$ is satisfied). This result contrasts with the exponential falling off in intensity given by a Maxwellian distribution of the electron velocities. A further result is that the Compton scattered radiation is not influenced by temperature or magnetic fields. W. S. S.

222. Dependence of Wave-Length of the Coefficient of Scattered Radiation by an Integrating Method of Measurement. G. Schanz. *Zeits. f. Physik*, 57. 9–10. *pp.* 669–691, 1929.

The scattered radiation coefficients with respect to the hardness of X-rays for hydrogen, paraffin, carbon, sodium, magnesium, aluminium and sulphur have been determined by an integrating method in which the radiator is installed at the middle point of an ionisation chamber formed of two concentric spheres. To eliminate absorption of scattered radiation by the scattering body itself, bodies of different thicknesses are used. The experimental results have been calculated by Glocker's theory and are in satisfactory agreement with the theoretical deductions.

H. H. Ho.

223. Emission of Soft X-Rays. U. Nakaya. *Roy. Soc., Proc.* 124. *pp.* 616–641, *July* 1, 1929.

All the experiments carried out in this investigation showed that the presence of adsorbed gas molecules on the photoelectric plate and target play an important rôle in the absorption and excitation of soft X-radiation. This is probable when we consider that all the phenomena concerned are to be taken as surface phenomena. As for the absorption of these rays, the effect of adsorbed gas molecules increases the efficiency of liberation of photoelectrons. E. E. F. d'A.

RADIOACTIVITY.

224. Radioactive Decay with Consideration of the Relativity Theory. C. Moller. *Zeits. f. Physik*, 55. 7–8. *pp*. 451–466, 1929.

It is pointed out how the calculations of Gamow and Kudar for the unidimensional case are to be carried through with consideration of the relativity theory. It turns out that Dirac's relativity theory of the single-body problem for α-particles actually yields the same results as the Klein–Gordon theory. The relation between the decay constant and the energy of the expelled particles experiences a small correction which is greatest peculiarly for small velocities of the particles. If the velocity of light is assumed to be infinite, then the results of Schrödinger's theory are obtained. Thus, there appears an error in the earlier calculations. J. J. S.

225. Wave Mechanics Derivation of the Radioactive Disintegration Constants. T. Sexl. *Zeits. f. Physik*, 56. 1–2. *pp*. 62–71, 1929.

The author completes the discussion outlined in a previous paper [see Abstract 2514 (1929)]. In the final calculations the values of the disintegration constant and expelled α-particle velocity for the emanations in the three radioactive families are used to determine the respective r_0 distances. Assuming these values, the experimentally determined α-particle expulsion velocities for the other elements in the families are employed to deduce the corresponding disintegration constants. Good agreement with the observed values of the latter is obtained. For r_0 values, see table.

Element	Ra-Em.	Ac-Em.	Th-Em.
$r_0 . 10^{13}$	9·70	8·65	9·40

W. S. S.

226. Differential Equation in Wave Mechanics Theory of Radioactive α-Particle Emission. T. Sexl. *Zeits. f. Physik*, 56. 1–2. *pp*. 72–93, 1929.

Mathematical investigation of the solutions of the differential equation $\frac{d^2y}{dx^2} + \left(1 - \frac{k}{x}\right)y = 0$, and their asymptotic expansions. This equation occurs also in hydrodynamics in the problem of the stability of Poiseuille's laminar flow. W. S. S.

227. Action of α-Rays on Solid Dielectrics. Hermine Folmer. *K. Akad. Amsterdam, Proc*. 32. 6. *pp*. 759–769, 1929.

A thin layer of pure paraffin was exposed to α-rays from polonium. Some of the effects observed are explained by the author as perhaps due to ionisation produced by the α-rays in the solid dielectric. Further experiments are to be carried out. J. J. S.

228. Penetration of α-Particles into a Simplified One-Dimensional Nucleus. R. H. Fowler and A. H. Wilson. *Roy. Soc., Proc*. 124. *pp*. 493–501, *July* 1, 1929.

The authors solve exactly for a simplified nucleus the problem of α-particle disintegration (determination of the complex characteristics of the wave-equation with the proper boundary conditions). They then proceed to discuss the converse problem of the penetration of an α-particle into the nucleus from without—a problem which is the basis of Gamow's theory of artificial disintegration. They find that the problem formally depends very much on whether the energy of the incident α-particle is or is not equal to the real part of a characteristic of the nucleus bombarded. They show that this type of penetration has features characteristic of a resonance effect, as one should expect. E. E. F. d'A.

229. Capture of Electrons by Swiftly Moving α-Particles. B. Davis and A. H. Barnes. *Phys. Rev.* 34. *pp.* 152–156, *July* 1, 1929.

A stream of electrons was superposed on a beam of α-particles moving in the same direction. The α-particle beam was subjected to a magnetic field which deflected the particles, those which had captured an electron being deflected less than those which had not. The scintillation method was used to count them, using various velocities for the electrons, both greater and less than that of the α-particles. Captures take place only with definite electron velocities which are related to velocities in the Bohr orbits of ionised helium as follows: if u is the velocity of the α-particle and v is the velocity of the electron in one of the Bohr orbits, there will be two values w and w' of the velocity of the electron stream at which capture takes place, such that $v = u - w$ and $v = w' - u$. When the number of captures is plotted as a function of the voltage impressed on the electron stream a series of maxima is obtained on each side of the equivalent volt-velocity of the α-particles, and these correspond to the energy levels of ionised helium. H. N. A.

V.33
1930

230. Measurement of Strong Polonium Preparations by the Transport of the Charge of the Emitted α-Particles. G. Ortner. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 3–4. *pp.* 117–123, 1929.

From the measurement of the charge of a known number of α-particles from polonium preparations the magnitude of their activity was determined. By this means was intended, and already in some cases has been carried out, the measurement of specially strong preparations (between 10,000 and 20,000 e.s. units current equivalent) with which the ionisation measurement, on account of the not even approximately attained saturation, has not the same reliability as with weaker preparations. The measurements made up to the present, which could be extended over only a small number of preparations (on account of the infrequent occurrence of very strong preparations), seem to give no systematic distinction between charge and ionisation measurement, if no surface disturbances occur. J. J. S.

231. High-Velocity Limits of Continuous β-Ray Spectra. J. A. Chalmers. *Cambridge Phil. Soc., Proc.* 25. *pp.* 331–339, *July*, 1929.

A method of obtaining approximately the high-velocity limits of continuous β-ray spectra by electroscope measurements is described. The β-ray bodies of thorium active deposit were examined by the method. The absence of thorium C γ-rays was confirmed, and its implications are discussed. J. J. S.

232. Nature of Cosmic Rays. P. Auger and D. Skobelzyn. *Comptes Rendus*, 189. *pp.* 55–57, *July* 1, 1929.

The suggestion put forward by Bothe and Kolhörster that cosmic rays are in reality not of γ-ray type but rather high-speed β-rays is shown to be inconsistent with the results of certain expansion chamber experiments. These show the immediate cause of the ionisation produced to be high-speed β-rays, but the frequent occurrence (4 times out of 27 " fruitful " expansions) of several high-speed β-ray tracks *in one expansion*, the tracks being near together and with almost the same directions, makes it almost certain that they arise in common from a ray of another character. Assuming the cosmic rays to be of γ-ray type and the high-speed β-rays to be Compton electrons produced by Compton scattering of the primary cosmic ray, the observed results are easily explained. W. S. S.

233. Modification of Collagen under the Action of the Radiations from Radioactive Bodies. J. Loiseleur. *Comptes Rendus*, 188. *pp*. 1570–1572, *June* 10, 1929.

A description of the results of experiments carried out on gelatin (ordinary gelatin or isoelectric, concentration 2 to 4 per thousand) or collagen prepared as by Nageotte. Radium or radon in a glass tube and with various filters was lowered into the solutions, and after a time the effect disclosed by a determination of the gold index or by observations of flocculation. Action on gelatin: Gelatin after an exposure of several days to 100 mg. of radium shows an increase of the gold index. This implies a diminution in the protective power of the colloid. Radon shows a similar action proportional to the amount of radon. Flocculation: A capillary tube containing 6–8 millicuries is surrounded after an hour or two with flocculent precipitates. The flocculation is observed if the medium is between acidity and the isoelectric point. The action is the more marked the purer the gelatin. The addition of mineral salts (KCl, $CaCl_2$) favours the precipitation. Similar results are obtained with collagen. The actions are not observed if the radium is surrounded with 0·15 mm. Pt or 0·15 mm. steel. The action is, therefore, due to β-rays. The effect of a rise of temperature from 0° to 37° is small. The action of heavy metals is very interesting, since, on adding acetate of lead ($\frac{1}{1000}$), the precipitates group themselves in a regular cone about the source of radiation and are coloured black by the metallic lead reduced by the radiation and absorbed by the flocculent mass. The action of gold chloride is very remarkable and shows flocculation in a few hours. A tube of 14 millicuries placed in a solution of collagen diluted to $\frac{1}{50}$ and having $\frac{1}{10000}$ of $AuCl_3$ is surrounded two hours later by a violet layer of flocculated collagen and coloured by the reduced gold. Thus, heavy metals sensitise the collagen to the radiations. W. V. M.

234. Chemical Action of Penetrating Radium Rays. A. Kailan. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 5–6. *pp*. 447–458, 1929.

The effects of the penetrating rays of radium on acetyl and benzoyl chloride were investigated. Acetyl chloride was exposed to the rays from 0·11 gm. of radium passed through 1 mm. of glass for 2000 hours. The conductivity increased tenfold, but the density remained unchanged. Benzoyl chloride exposed to the radiations for three times as long as the acetyl chloride became yellow, and showed a somewhat lower density and a thirty-fold conductivity. Benzoic acid was obtained as a product of the reaction. F. J. B.

235. Sublimation of Radium B and Radium C in Relation to the Nature of the Support. L. Walchshofer. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 5–6. *pp*. 363–388, 1929.

The temperatures at which different proportions of RaB and RaC were driven off were investigated, using as supports gold-copper and gold-silver alloys, silver, copper, carbon, invar steel and mica. The sublimation curves of the active deposit from the alloys investigated show a remarkable parallelism with the solidification curves of each set of alloys. The effects of oxidation of the support are considered, also the possibility of the active deposit forming alloys with the metal of the support. H. N. A.

236. Condensation of Radioactive Substances on Solid Surfaces. G. H. Henderson. *Cambridge Phil. Soc., Proc.* 25. *pp.* 344–346, *July,* 1929.

Experiments in which the active deposit from radon was formed on a copper disc at the temperature of liquid air indicated that the emanation atoms only remain adsorbed on the surface a short time and again fly off. The occurrence of contamination aggregates when deposits of polonium were formed is described. J. J. S.

237. Dependence of δ-Radiation on the Degree of Outgassing of Platinum Foil. S. Matthes. *Ann. d. Physik,* 2. 6. *pp.* 631–645, *Aug.* 26, 1929.

An experimental arrangement is described for measuring the electron emission produced by bombarding platinum foil with α-particles (δ-ray emission), arrangements being made for outgassing the foil *in situ* by means of a heating current. The emission of a fresh foil depends on its previous history; on first glowing out, the δ-ray emission increases, but on further glowing to higher temperatures, a decrease to a steady value (below the initial value) is observed. Admission of gas to the apparatus leads, on subsequent exhaustion and measurement, to a repetition of this cycle of changes in the emission. Air and hydrogen act similarly in this respect. The results serve as contributory evidence to the view that the electron emission (δ-radiation) is due principally to gas in between the metal atoms, the form and arrangement of the latter merely modifying a little the characteristics of the emission. W. S. S.

238. Use of Valve Electrometer for Research on Proton Rays. E. A. W. Schmidt and G. Stetter. *Akad. Wiss. Wien, Ber.* 138. 2*a*. 5–6. *pp.* 271–287, 1929. *Zeits. f. Physik,* 55. 7–8. *pp.* 467–482, 1929.

The possibility of the application of the valve electrometer [see Abstracts 2209 and 3085 (1929)] to the analysis of mixtures of corpuscular rays is considered, and as an example a research with α-rays from ThC is discussed. With the object of extending the application to proton rays an investigation was made of the specific ionisation by natural H-particles in bundles of rays of approximately uniform velocity which were obtained by liberation with α-rays from a polonium preparation. The measurements carried out with H-ray bundles of different velocities and under various angles gave a proportion of 1 : 4 between the ionisation by H- and α-rays. The results registered with the valve electrometer with natural H-rays very much excel those yielded by the collision theory. Comparing the numbers obtained from H-rays with the valve electrometer and by scintillation observation, the measurements gave for the latter considerably higher values. J. J. S.

HEAT.

239. Heat Flow when the Boundary Condition is Newton's Law. J. H. Awbery. *Phil. Mag.* 7. *pp.* 1143–1153, *June*, 1929.

The general problem of a body from which the heat loss at one or more surfaces is proportional to the excess temperature at the point, over that of the air, is considered, with reference to those cases where the final steady state is not one of uniform temperature. Two illustrative cases are worked out: (1) the case of a cable buried in the ground; (2) the case of a conducting girder projecting into a layer of insulation. J. J. S.

240. Influence of Boundary Layer on Temperature Fields. J. Schmekel. *Zeits. f. angew. Math. und Mechanik*, 9. *pp.* 101–109, *April*, 1929.

A continuation of previous work, viewing the same problem from a different standpoint [see Abstract 1657 (1928)]. The experimental results of Soennecken and Stender upon the cooling of a tube in a stream of fluid, and conversely the free cooling, etc., are shown to exhibit differences in accordance with the theory of Prandtl. The mode of movement of the fluid is discussed, and as a particular case the periodic disturbances are investigated for a flat smooth plane wall. Finally, for large movements the criterion for the size of the Reynolds coefficient is deduced, as well as a discussion of the origin of turbulence in a liquid by its own heat. S. G. B.

241. Measurement of the Effective Wave-Lengths of Screens Used in Pyrometry. Mendousse. *Comptes Rendus*, 189. *pp.* 30–32, *July* 1, 1929.

The effective wave-length $\lambda_{T_1T_2}$ is the wave-length for which the ratio Z of the spectral brightnesses of two black bodies, at temperatures T_1 and T_2, is equal to *z*, the ratio of the total fluxes which they send through the screen. Z is studied by means of a special spectropyrometer, using an ordinary disappearing filament and a monochromatic glass. The total flux is studied with a precision pyrometer, with disappearing filament, the screen of which is replaced by the screen which is being studied. A rotating sector is employed to obtain about the same brightness, when the source with high colour temperature T_2 is observed as was obtained with the source having colour temperature T_1. In this way good values of the effective wave-length can be obtained when T_1 and T_2 are sufficiently far apart. H. N. A.

242. Resistance Thermometers. R. Sewig. *Zeits. f. Instrumentenk.* 49. *pp.* 305–306, *June*, 1929.

In order to avoid errors due to the differences of the temperature coefficients of the metals used as thermometers and as comparison resistances, the recommendation is made that the comparison resistance (with small temperature ceofficient) and the thermometer resistance (with large temperature coefficient) should in common, as far as possible on a joint support, be both exposed to the measured temperature. J. J. S.

243. Thermostat Constant to One-Thousandth of a Degree Centigrade. F. R. Winton. *Journ. Sci. Instruments*, 6. *pp.* 214–217, *July*, 1929.

A toluene-mercury thermo-regulator, with variable resistance contact in the grid circuit of a thermionic valve, controls the anode current which passes through a heating coil in the bath. A change of bath temperature amounting to 0·0001° C. is compensated by 5 to 10 % change in the heating current. AUTHOR.

244. Relation between Boiling Point and Molecular Structure of Cis- and Trans-Ethylenic, Saturated and Acetylenic Acids. Bourguel. *Comptes Rendus*, 188. *pp.* 1494–1496, *June* 3, 1929.

In a table, and graphically, the boiling points of the different acids are shown. The ethylenic acids fall into two series, one containing those arising from catalytic action and the other those from isomerisation by iodine. The saturated acids link up with the former and the acetylenic acids with the latter. As the boiling point depends on molecular weight and structure, this confirms the tetrahedric scheme. A comparison of the refractive indices, molecular refractions, densities, and increase of molecular refraction in pairs, shows that all the physical constants are smaller for equal molecular weights for the cis-acids. R. S. R.

245. Liquid Mixtures of Tellurium and Sodium Telluride. Part I. Specific Resistance as a Function of Composition and Temperature. C. A. Kraus and S. W. Glass. *J. Phys. Chem.* 33. *pp.* 984–999, *July*, 1929.

The equilibrium diagram for the melting points of tellurium and sodium telluride was determined. The two components were found to be completely miscible in the liquid phase. Sodium and tellurium were found to form two compounds Na_2Te_2 and Na_2Te_6 in addition to the normal telluride. Na_2Te_2 has a transition point with the normal telluride at 355° C., and Na_2Te_6 has a congruent melting point at 436° C. Eutectics were formed between Na_2Te_2 and Na_2Te_6, and between Na_2Te_6 and tellurium. The results of the resistance method were in agreement with those of thermal analyses. F. J. B.

246. Under-Cooled Melts. H. Pollatschek. *Zeits. f. phys. Chem.* 142. *Abt. A.* 4. *pp.* 289–300, *July*, 1929.

A method for the determination of the temperatures at the solid-liquid boundary during the crystallisation of under-cooled fused substances. Contrary to the conclusions of G. Tammanns, the fusion-temperature of the substance is not reached at this boundary. A. D.

247. Lowering of Freezing Point of Solutions Containing Two Electrolytes. R. Wesoe. *Phys. Zeits.* 30. *pp.* 412–419, *July* 1, 1929.

By aid of Debye and Hückel's theory of strong electrolytes the values of $1 - f_0$ (where f_0 is the osmotic coefficient), as deduced from freezing-point lowering observations, are compared with the theoretical values (detailed calculations are given) for solutions of various concentrations for all possible mixtures of the salts magnesium sulphate, calcium nitrate and potassium sulphate and nitrate, and in the case of the two last also for mixtures in the ratios 1 : 4, 1 : 2, 2 : 1 and 4 : 1. Concentration is deduced from conductivity measurements, and temperatures are determined by a constantan-copper couple. The results support the theory for dilute solutions. Numerous tables and curves are given. C. A. S.

248. Volume Changes of Glasses over the Softening Range. G. Tammann and W. Jellinghaus. *Ann. d. Physik*, 2. 3. *pp.* 264–284, *July* 15, 1929.

The three glasses selenium, salicin and colophony have been studied. It is shown from the determination of the influence of pressure and temperature on volume that over the softening range the isotherms for various temperatures intersect at pressures below 1000 kg./cm.^{2}. Therefore, at high pressures the volume at constant pressure first decreases with increasing temperature and then increases; that is, the volume isobars at high pressures show over the softening range weak minima. F. J. W.

249. Specific Heat and Heat of Fusion of Calcium and Magnesium. E. Zalesinski and R. Zulinski. *Acad. Polonaise Sci. et Lettres, Bull.* 9–10A. *pp.* 479–505, *Nov.–Dec.,* 1928. *In German.*

After a review of previous literature and a statement of the values therein recorded, the authors give details of their method to obtain the mean specific heat of calcium in the range 150° to its melting point, 810°. Magnesium was treated in like manner, and in both cases the heat of fusion was determined both by calorimetric methods and by observation of the time of crystallisation. The results are set out in the following table:—

Metal.	Temperature Range	Specific Heat.	Atomic Heat.	Heat of Fusion.
		cal./g.		
Ca	20–304	0·1610	6·45	Calorimetric, 78·5 cal./g.
	20–504	0·1764	7·07	
	22–520	0·1768	7·08	
	20–697	0·1887	7·56	
	21–755	0·1927	7·72	Crystallisation data, 74·0
	22–785	0·1901	7·67	
	22–785	0·1724	6·91	
	22–802	0·1724	6·91	
	810–930	0·2670	10·70	
Mg	22–625	0·2823	6·86	Calorimetric, 55·5 cal./g.
	650–775	0·2880	7·00	
		0·2800	6·81	Crystallisation, 46·0

Full experimental results are given and a detailed description of procedure. The method is vindicated by application to Pb, Bi, Sn, Ag, and other metals. S. G. B.

250. Proof of Transformation of Ortho- into Para-Hydrogen by Specific Heat Measurements. A. Eucken and K. Hiller. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 142–157, *June,* 1929.

In ordinary hydrogen the modifications occur in the ratio 1 : 3, but the present authors show that at low temperatures and high pressures inter-transformation takes place in the course of a few days. Detailed experiments are described showing the course of this transformation by means of exact measurements of molecular heats, and a curve is included showing the dependence of the transformation velocity constant upon the concentration. H. H. Ho.

251. Specific Heats of Para-Hydrogen in Solid, Liquid and Gaseous States. K. Clusius and K. Hiller. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 158–168, *June,* 1929.

A relatively simple installation is described for preparing para-hydrogen in large quantities and under pressure. The specific heats of liquid and solid para-hydrogen, and also the heats of fusion, have been evaluated, and within the limits of experimental error these quantities are in agreement with those of ordinary hydrogen. The specific heat of para-hydrogen exceeds at 115° K. the classical value for the diatomic rotator as demanded by the new quantum theory, and has now been determined up to the value of 2·7 cal. at 160° K. H. H. Ho.

252. Reversible Inter-Transformation of the Two Hydrogen Modifications. H. Senftleben. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 169–173, *June,* 1929.

In this paper an experimental arrangement is described which, by relatively simple means, enables the reversible intertransformation of both species of molecular hydrogen to be made visible to large audiences. H. H. Ho.

253. Specific Heats of Mineral Oils by a New Method. L. M. Henderson, S. W. Ferris and J. M. McIlvain. *Indust. and Engin. Chem.* I. *pp.* 148–151, *July* 15, 1929.

This method consists essentially in measuring the electrical energy necessary to raise the temperature of a given weight of oil a definite number of degrees in a definite period of time under carefully controlled conditions. The procedure is repeated after a large part of the oil is withdrawn and the brass stirring paddle is replaced by a brass barrel of the same weight, the liquid level being kept constant. These conditions correspond with the following simultaneous equations, in which the terms involving the heat capacity of the calorimeter and heat loss cancel. The heat of stirring is negligible. When the paddle is used, $Q_1t + s_1t = m_1c\Delta T + k\Delta T + L$, and when the barrel, $Q_2t + s_2t = m_2c\Delta T + L$, from which $c = \frac{(Q_1 - Q_2)t}{(m_1 - m_2)\Delta T}$, where Q is the electrical energy input per sec. in cals., t the time in seconds for the temperature to rise $\Delta T°$, s the calories per sec. developed by stirring, m the weight of liquid in grammes, c the average specific heat of the oil over the range ΔT, k the apparent average specific heat of the apparatus over the range ΔT, and L the heat lost to the environment. The values obtained vary with the source of the crude oils, paraffinic oils showing higher specific heats than naphthenic oils of similar temperature and specific gravity. The temperature gradient for the specific gravity corresponds with that given by Fortsch and Whitman's equation [Abstract 2892 (1926)]. T. H. P.

254. Vapour Pressure Constant of Neon. K. Clusius. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 1–13, *June,* 1929.

In the vapour pressure equation for a monatomic ideal gas occurs an integration constant j_p. The author has determined the specific heats of neon in the solid, liquid and hypercritical states, and making use of the vapour pressures of solid neon has found for the vapour pressure constant the value $+ 0\cdot39_6 \pm 0\cdot040$. This value agrees well with the theoretical one $+ 0\cdot37_0$, so that the assumption of different quantum weights for the gas and the condensate is not necessary. H. N. A.

255. Reversible Cycle. G. D. Mattioli. *N. Cimento,* 6. *pp.* 230–235, *May,* 1929.

The author suggests a new view of cycles as being not necessarily reversible in all details, but as on the whole restoring the original condition.

The new view keeps account of the essential significance of the Second Principle; and it also permits Clausius' theorem to be inverted, showing that Clausius' equation is not only necessary but sufficient, for a cycle to be reversible. It follows that inequality is applicable to real cyclic transformations. This is generally assumed; the author shows its necessity.

A. D.

256. Expansion of Gases on Mixing, Especially at Very Low Pressures. Its Relation to the Empirical Calculation of the Fugacities in Gaseous Mixtures. L. J. Gillespie. *Phys. Rev.* **34.** *pp.* 352–366, *July* 15, 1929.

The fugacity of a gas, f, is its pressure, p, corrected for the deviations of the gas from the law of ideal gases $pv = \mathrm{RT}$. It is the principal advantage of the fugacity that it can be calculated from an equation of state. The empirical calculation of fugacities from the pressure data of gaseous mixtures is in general improved by, if it does not in fact require, some knowledge of the expansions at zero pressure. The author shows that the expansion of gases on mixing to form a mole of mixture from the pure gases at constant temperature and pressure, when plotted as a function of the pressure, does not vanish at zero pressure. The mixtures dealt with are ethylene and argon, ethylene and oxygen, nitrogen and hydrogen, and nitrogen and methane, for which experimental data have been given by Masson and Dolley, Keyes and Burks, and others. Tables and curves are given in illustration.

T. B.

257. Deduction of Boltzmann Energy Law by Introduction of Material Wave Forms. A. Haas. *Akad. Wiss. Wien, Ber.* **138.** *2a.* 5–6. *pp.* 459–468, 1929.

The Boltzmann energy formula can be deduced from the Gibbs formula for the canonical energy distribution. From the latter the logarithm of the statistical probability can be shown to be equal to $(\mathrm{E} - \psi)/\theta$, where E is the total energy and θ the distribution modulus, which is proved universally to be, for purely kinetic energy, proportional to the temperature. The factor ψ is discussed for the case of the introduction of material waves, whereby the identity with the free energy is established. From this is developed directly the Boltzmann law for entropy, which is shown to be valid not only for the case of the ideal monatomic gases, but also for the general case of an ideal solid body (vibrating quantum system).

S. G. B.

258. Decrease of Entropy in a Thermodynamical System by Intervention of an Intelligent Being. P. Clausing. *Zeits. f. Physik,* 56. 9–10. *pp.* 671–672, 1929.

This is a mathematical note in which the author endeavours to show that Szilard in his paper with the above title [see Abstract 2536 (1929)] has made an error which invalidates his conclusions.

T. B.

259. Value of "b" and Mol-Refraction. W. Herz. *Zeits. f. Elektrochem.* 35. *pp.* 457–458, *July,* 1929.

In continuation [see Abstract 908 (1924)], the values of b_{K} and of the mol-refraction MR are collected, and the ratio $\mathrm{MR} : b_{\mathrm{K}}$ is calculated. These magnitudes depend on the true molecular volume, but their ratio is not constant; it varies between 3 and 5 for four-fifths of the substances examined. Lower values are obtained in the case of associated substances or of substances of low boiling point.

G. E. A.

SOUND.

260. Experimental Exploration of Upper Atmospheric Layers. H. Hergesell and H. Benndorf. *Phys. Zeits.* 30. *pp.* 429–430, *July* 1, 1929.

H. Hergesell, in criticising an earlier paper by H. Benndorf [see Abstract 2790 (1929)], states that most of the published facts were known for some time by a commission containing aerology, geophysics and explosive experts. He suggests means to get better results, including meteorological data, wireless time signals, choice and siting of stations, and the development of the theory. **H. Benndorf** replies. R. S. R.

261. Velocity of Sound Determination Based on Kinetic Theory of Gases. S. Drzewiecki. *Comptes Rendus*, 189. *pp.* 122–125, *July* 17, 1929.

A graphical method of dealing with the molecular and translational velocity vectors is described, from which it is shown that the limiting speed of translation is $\sqrt{1/2}\,\overline{\Omega}$, where $\overline{\Omega}$ is the quadratic mean molecular velocity. For air, this gives the value 343 m./sec. When the initial shock of pressure is sufficient to cause the limiting speed to be attained the resulting wave becomes audible. G. E. A.

262. Characteristics of Acoustic Tubes. K. Kobayasi. *Tohoku Univ., Technol. Reports*, 8. 3. *pp.* 65–119, 1929. *In English.*

(1) A mathematical treatment of the transmission characteristics of a system of short tubes of various cross-sections and the analogous electrical circuits. (2) A theoretical and experimental treatment of hair felt as a sound absorbent. A direct method for measuring extremely small acoustic impedances is described. (3) The characteristics of a rubber tube are treated as an example of an acoustic tube with non-rigid wall. A Bibliography of 38 references is given. W. H. Ge.

263. Experimental and Theoretical Mid-Series Characteristic Impedance of Acoustic Wave Filters. G. W. Stewart and C. W. Sharp. *J.O.S.A. and R.S.I.* 19. *pp.* 17–28, *July*, 1929.

The simplified theory of Stewart and the less approximate theory of Mason are compared with experimental measurements with respect to the mid-series characteristic acoustic impedance of high-pass, low-pass and single band-pass filters. The comparison is made over a large range of frequencies, including a considerable portion of both the attenuation and transmission regions. There is remarkable agreement between theory and experiment, considering the approximations that are made in the theories. For the low-pass filter there seems to be no appreciable advantage of the more accurate theory of Mason. In the other two cases, however, there is a distinct superiority for this theory. For purposes of ascertaining cut-offs, and the characteristic impedance for the low-pass filter, the simpler theory of Stewart is more readily applicable. Authors.

264. New Directional Sound Receiver. C. v. Hofe. *Zeits. f. Instrumentenk.* 49. *pp.* 331–341, *July*, 1929.

A description is given of a new directional receiver for sounds travelling through the atmosphere. The principle on which the receiver operates is as follows. Two reflectors in the form of paraboloids of revolution are so arranged that sound received from a direction normal to the line joining their foci is reflected through a pair of ellipsoidal tubes to both ears of the observer. The reflectors and connecting tubes are so arranged that sound coming from a direction on, say, the left of the observer can only enter the left connecting tube, the sound received by the right reflector being reflected outside the entrance to the right connecting tube. Thus an accurate estimate of direction is obtained, only a small angle of rotation of the instrument being sufficient to cut off the sound from one ear or the other. In the actual apparatus two pairs of paraboloidal reflectors are employed, one pair arranged for direction-finding in a horizontal plane, and a second pair, arranged at right angles to the first and connected to the observer's ears by ellipsoidal tubes with a right-angled bend, for direction-finding in a vertical plane. A theoretical discussion is given of the principles on which the operation of the receiver is based, and experimental tests on the apparatus, which is made by Goerz, are described. A. W.

265. Velocity of Sound in Sea-Water. E. Lübcke. *Zeits. f. techn. Physik*, 10. 9. *pp.* 386–388, 1929.

An accurate value of the velocity is necessary for the determination of depth by the echo method, and for distance measurement by simultaneous dispatch of radio-electric and water-sound signals. Measurements have been made [see Abstract 1906 (1923)] which allow of a control of the calculated velocity. The latter depends on the adiabatic compressibility and density of the water, and these quantities change with the temperature, salinity and pressure. It may be taken that, approximately, the velocity increases 0·2 % for 1° C. rise, 0·11 % for 100 m. increase in depth, and 0·1 % for 1 % increase in salinity. In the application to echo sounding, the velocity at first diminishes, owing to the fall of temperature, and afterwards increases on account of the increase in pressure. Leaving on one side the coldest and warmest seas, an average velocity for all depths is found to be 1496 m./sec., and an international average value of 1500 m./sec. is suggested for ordinary navigational purposes. G. E. A.

266. Vibrating Mirror for Producing Compound Oscillations. W. Pupp. *Phys. Zeits.* 30. *pp.* 427–428, *July* 1, 1929.

In order to compound two Lissajou vibrations, the author projects successively upon two mirrors vibrating at right angles to each other a strong beam of light. The mirrors are mounted in a kind of bifilar suspension, the two fibres being stretched steel wires and the mirror being carried on a lever projecting on both sides and attached at one end of the lever. The vibration is kept up by an electromagnet and can be adjusted as to frequency by altering the tension of the wires. Pictures up to 4 metres in diameter can be thrown on a screen and tuning can be carried on in the course of the experiment. E. E. F. d'A.

ELECTRICITY AND MAGNETISM.

ELECTROSTATICS, TERRESTRIAL ELECTRICITY AND MAGNETISM.

267. Contact Potential Measurements with Adsorbed Films. I. Langmuir and K. H. Kingdon. *Phys. Rev.* 34. *pp.* 129–135, *July* 1, 1929.

Measurements have been made of the contact potential differences between a clean unheated tungsten filament, and the same filament coated with an adsorbed film of thorium, cæsium, oxygen, or a mixture of cæsium and oxygen. The method used is well adapted to prevent accidental contamination of the filament surfaces. The values found for the contact potentials between cold surfaces are: Cs-O-W—W, 3·1 volts; Cs-W—W, 2·8 volts; Th-W—W, 1·46 volts; W—OW, 0·8 volt. The surface on the left is positive to that on the right. These values of the contact potential do not agree with those calculated from the thermionic emission constants. An example is given of the application of the method to the measurement of the changes in the work function produced by heating a tungsten filament to various temperatures in presence of cæsium vapour, thus changing the amount of adsorbed cæsium. AUTHORS.

268. Volta Effect in Water Vapour and Hydrogen. E. Dubois. *Comptes Rendus*, 189. *p.* 93, *July* 8, 1929.

Confirms previous experiments [see Abstract 3103 (1928)] by placing the electrodes at the two ends of a vacuum tube which can be separated by a cock, and producing the vacuum in each end alternately. The action of water vapour and hydrogen is studied. E. E. F. d'A.

269. Electrostriction in Insulating Liquids. G. Bruhat and M. Pauthenier. *J. de Physique et le Radium*, 10. *pp.* 209–218, *June*, 1929.

Earlier studies showed some contradictions between experiment and thermodynamic theory [see Abstract 2193 (1928)]. New expressions are now given for isothermal and adiabatic electrostriction in which the Lorentz-Lorenz formula is no longer introduced and only directly measurable quantities are employed. This shows sufficiently good agreement between theory and experiment for CCl_4, and to a less extent for C_6H_6, but for CS_2 the difference is greater than the errors of measurement. In a discussion for CS_2 the non-reversibility of adiabatic electrostriction is ruled out and also the possibility of heterogeneity of temperature or electrical field in the liquid. It is considered that dissolved gases play a part in explaining the difference in the results. R. S. R.

270. Direct Determination of the Electrostatic Moments of Molecules. R. J. Clark. *Roy. Soc., Proc.* 124. *pp.* 689–698, *July* 1, 1929.

An account is given of some measurements made by a direct method of determination of moments, with the object of showing that the moments were permanent, were developed in chemically polar substances and were directly measurable. The results indicate that the moments of As_2O_3 is of the right order of magnitude to agree with the theory of permanent dipoles put forward by Debye, and is not influenced by the strength of the field, but appears to be a permanent characteristic of the molecule. The method is not delicate enough for the determination of the moments of atoms, as experiments with potassium and sodium have shown.

H. H. Ho.

271. True and Apparent Electrical Resistivity of Dielectrics. H. Saegusa and K. Saeki. *Tohoku Univ., Sci. Reports*, 18. *pp.* 231–244, *June*, 1929. *In English.*

Putting the expression of opposing potential due to polarisation into Richardson's equation of the electrical current in dielectrics, the expression of apparent resistivity as a function of true resistivity, charging time and material constant is deduced. Using former experimental results it was found that the apparent resistivity increases with the charging time, and after 20 minutes for quartz $\perp$ and 40 minutes for quartz II, it becomes nearly equal to the maximum values ($t = \infty$), and the ratio of the maximum resistivity to the initial value is respectively 5·41 and 1·18 for quartz $\perp$ and quartz II. The experiment for quartz is made, and a good coincidence between both results is shown. The true resistivity for quartz $\perp$ is calculated as equal to $2 \cdot 7 \times 10^{14}$ ohm cm. at the temperature 12° –15° C.

AUTHORS.

272. Dipole Moment of Symmetrical Trinitrobenzene. A. Parts. *Zeits. f. phys. Chem.* 4. *Abt. B.* 3. *pp.* 227–233, *July*, 1929.

Results are given of determinations of the dielectric constants of solutions of symmetrical trinitrobenzene in benzene by means of a suspension apparatus, results accurate to a few units in the fourth decimal place being obtained. The total polarisation of the trinitrobenzene is found to be 54, and is independent of the concentration up to 0·0389 mol. and of the temperature between 10° and 50° C. Since optical data give the value 40 for the electron polarisation, the remaining 14 represents the atomic and dipole polarisation. Only if atomic polarisation is absent does the dipole moment amount to $\mu = 0 \cdot 8 \times 10^{-18}$. [See Abstract 1390 (1928).]

T. H. P.

273. Problem of the Additivity of Molecular Dipole Moments. A. Eucken and L. Meyer. *Phys. Zeits.* 30. *pp.* 397–402, *June* 15, 1929.

The authors investigate the validity of the dipole additional rule from a new calculation of molecular dipole moments in which the standpoint is not, as hitherto, based on the moments of the separate groups, but more rigorously on the moments of the separate unions. In this way important information has been disclosed concerning the orientation of the resulting moment. Based on the stereochemical rotation of the separate groups there has emerged a hitherto unobserved case of a polarisation which invalidates the apparent moment of many Ca_4— compounds. [See Abstract 2945 (1929).]

H. H. Ho.

274. Determination of Dipole Moments by the Method of Dilute Solutions. O. Werner. *Zeits. f. phys. Chem.* 4. *Abt. B.* 4. *pp.* 312–320, *July*, 1929.

A discussion is given of the significance and the possibility of determining single components in a complete polarisation curve. Measurements of the dielectric constant of solutions of tetra-isoamyl ammonium picrate in benzol are described, and it is shown from the polarisation curve that there is a splitting up of the ions of this salt in solution in benzol which makes a determination of the electric moments by the method of dilute solution impossible. F. S.

275. Dielectric Polarisation of Liquids. Part V. Atomic Polarisation. C. P. Smyth. *Am. Chem. Soc., J.* 51. *pp.* 2051–2059, *July*, 1929.

In previous communications [see Abstract 2826 (1928)] the total polarisation has been divided into three parts, *viz.*, electronic, atomic and orientation polarisation due to the permanent moments of the molecules, and the present paper is confined to the significance of atomic polarisation for which values of a large number of substances have been calculated or taken from the literature. The binding forces calculated by Bates and Andrews [see Abstract 1820 (1928); *Chem. Rev.* 5. p. 533, 1928] from thermal data and by the writer from refractions are found inadequate to account for the differences between the displacements of the different nuclei and groups in the molecules. The atomic polarisation is not generally an additive quantity, but tends to be greater, the greater the number of atomic nuclei or groups in the molecule, the greater the number of electric doublets and the more unsymmetrical the arrangement of these doublets in the molecule. In the calculation of the electric moment of a molecule, the atomic polarisation may be disregarded without risk of introducing appreciable error only when the moment is high and the molecule is small but contains one or two electric doublets. H. H. Ho.

276. Molecular Polarisation. G. Jung and A. Schleede. *Zeits. f. phys. Chem.* 4. *Abt. B.* 3. *pp.* 207–216, *July*, 1929.

Theories of molecular polarisation are discussed and it is concluded that not only is the molecular polarisation of molecules of asymmetric structure (dipole molecules) dependent on temperature, but also that of molecules of symmetric but unfixed structure (molecules with freedom of rotation). The molecular polarisation is, in the first case, according to Debye, given by an equation of the form $P_{\text{fixed}} = a + b/T$. The calculation for a molecule symmetric but of unfixed structure gives the expression $P_{\text{unfixed}} = a' - b'T$. Since the dependence on temperature in the latter case is of a somewhat different kind the possibility is given in principle of distinguishing between two kinds of molecules, asymmetric fixed and symmetric unfixed. J. J. S.

277. New Method for Measuring Dielectric Constants of Conducting Liquids. A. Astin. *Phys. Rev.* 34. *pp.* 300–309, *July* 15, 1929.

A modified resonance method for determining the dielectric constants of conducting liquids is described in which no correction is necessary for the conductivity of the dielectric. The circuit contains an inductance in parallel with two series condensers, one of which is either shunted by a resistance or contains the conducting liquid as its dielectric. The vacuum-tube voltmeter is found a more sensitive resonance indicator than a thermocouple and is connected to measure the p.d. across the shunted condenser. It is shown theoretically and experimentally that the capacity of the condenser for maximum p.d. across it is independent of the parallel resistance. A preliminary curve is given showing the variation of the dielectric constants of weak KCl solutions with concentration. The dielectric constant decreases, reaching a minimum at a concentration of 0·0005 mol. per litre. The average activity coefficient of the ions calculated by means of Hückel's equation is 1900. This result is checked by using two condensers of different size and shape. Readings from the two condensers agree only when the coupling with the oscillator is extremely loose. The lowering obtained is much greater than that reported by any other observers, but results very similar to those of the latter are obtained when the coupling is increased slightly. The frequency employed is 3×10^6, the highest value at which lead-wire effects are negligible. No change of the dielectric constant with different applied fields is found for a 0·0005 normal KCl solution. Previous values for sugar solutions are checked. Standardisation of the condensers is with benzene, and its dielectric constant is determined by a method devised for non-conducting liquids, which gives directly absolute values, and which for benzene is $2\cdot239 \pm 0\cdot005$ at 25° C. The dielectric constant of water obtained from a comparison with benzene is $79\cdot5 \pm 0\cdot5$ at 25° C. H. H. Ho.

278. Dielectric Constants of Benzene Oxime and Ketone Solutions. O. Hassel and E. Næshagen. *Zeits. f. phys. Chem.* 4. *Abt. B.* 3. *pp.* 217–222, *July*, 1929.

The small increase of the dielectric constant of benzene by solution of oximes shows that already in small concentrations association leads to cancellation of the dipole moment. For the O- ester of anti-benzaldoxime the dipole moment was found to be $\mu = 0\cdot86 \times 10^{-18}$ e.s.u. The bringing in of phenol in place of alkyl raises the dipole moment of the aliphatic ketone. For acetone $\mu = 2\cdot72 \times 10^{-18}$, for acetophenone $\mu = 2\cdot97 \times 10^{-18}$, and for benzophenone $\mu = 3\cdot13 \times 10^{-18}$ e.s.u. J. J. S.

279. Atmospheric and Terrestrial Electricity. E. Leclerc. *Assoc. Ing. Él. Liége, Bull.* 7. *pp.* 33–54, *March–April, and pp.* 58–73, *May–June*, 1929.

The author reviews the general facts regarding the existence, effects produced by and possible causes for (1) the static field in the atmosphere, (2) free charges in the atmosphere, (3) terrestrial magnetism, and (4) earth currents and the aurora. R. S. R.

280. Some Thundercloud Problems. C. T. R. Wilson. *Frank. Inst., J.* 208. *pp.* 1–12, *July*, 1929.

A thundercloud is regarded as bipolar, positive above, this being due to negatively charged particles therein being larger, and so falling more quickly than the positively charged ones. This process continues until the field so caused stops further relative movement, or the sparking limit is reached. The average electrical moment destroyed in a discharge within a cloud being 10^{16} e.s.u., initial rate of regeneration of field one-tenth the maximum value per second, and intensity of field required to produce discharge 10,000 volts per cm., it is deduced for a cloud horizontal above and below, 1 km. thick and of total volume of 4 km.^{3}, that the energy of the discharge is about $1\cdot6 \times 10^{17}$ ergs, and the potential difference before discharge 10^9 volts. It is then shown that the rate of regeneration of charge is consistent with the above theory, its sign being explained by the fact that a neutral drop falling through a field of positive potential gradient at a speed greater than that at which a positive ion is drawn up

will acquire a negative charge. The positive charge of rain is due to the reverse process below the cloud. Ionisation is attributed mainly to the field itself. Showers and thunderstorms account for the negative charge of the earth, and maintain a potential of about 1,000,000 volts in the upper atmosphere. The possibility of applying, by means of thunderstorms, voltages of the order of 10^9 volts to an electron or atomic nucleus is mooted, and it is pointed out that this actually occurs in a thundercloud, which may partially account for Millikan's cosmic rays.
C. A. S.

281. Lag between Solar Activity and Magnetic Activity. H. W. Fisk. *Terr. Mag.* 34. *pp.* 147–150, *June*, 1929.

The author extended the investigations of Chree and Bauer to the 22-year period and employed a modified Fourier series to fit the observations. These suggest a half-yearly lag. Support is also given to the view of Goschl that both effects are dependent on a rhythmic orbital planetary motion, and are therefore periodic. Finally, observed, modified, smoothed and computed values and the residual values are tabulated for both quantities. The differences of the computed sunspot and characteristic numbers show the change of sign from a maximum to a minimum.
R. S. R.

282. Cosmical Magnetic Phenomena, S. Chapman. *Nature*, 124. *pp.* 19–26, *July* 6, 1929. *Supplement.*

Magnetic phenomena have been observed only on the sun and the earth, and in the former case indirectly by means of the Zeeman effect. A daily magnetic variation due to the moon is caused by a tidal motion of the earth's atmosphere. Some parts of the magnetic history of the earth may possibly be read from the magnetisation of rocks. Gilbert's demonstration of the internal origin of the earth's magnetism was confirmed by Gauss, and later analyses indicate an external origin for about 3 % of the surface field. The earth's field extends through the atmosphere and far beyond it, but few or no tubes of force pass through the solar atmosphere into outer space [see Abstract 1078 (1918)]. The sun's field is nearly symmetrical about an axis inclined at 4° to the axis of rotation, and it rotates in 31 days as compared with 26 days for the solar surface. The polar intensities on the earth and the sun are $\frac{2}{3}$ gauss and 50 gauss respectively, but in sunspots intensities of 3000 gauss are frequent. Attempts to provide a theory of the origin of the earth's magnetism have not been definitely successful, and hypotheses include that of the presence of magnetic material within the earth. The action of the surface layer which has a temperature below the critical point is, however, insufficient to account for the main field. Other theories are based on the action of electric currents flowing inside the earth round the magnetic axis [see Abstract 201 (1920)], or on the effect of rotation as an essential feature [see Abstract 2582 (1927)]. The study of earth magnetism may, in time, add materially to our knowledge of the earth's interior. Schuster showed that the facts relating to the daily variation do not agree with the assumption that the earth is a uniformly conducting sphere. The necessary effective sphere has its surface 200 miles below that of the earth, and its resistivity is 400 to 4000 times less than that of dry rock. Hence a great change in composition or state must occur about this depth. Certain fundamental problems in solar and terrestrial magnetism still await solution.
G. E. A.

283. Comets and Terrestrial Magnetic Storms. H. B. Maris and E. O. Hulburt. *Phys. Rev.* 33. *pp.* 1046–1060, *June*, 1929.

A recent theory of the authors attributed terrestrial magnetic storms and auroral displays to the effect of unusual flares of ultra-violet light from the sun falling upon the terrestrial atmosphere. Such flares would be expected to cause changes in comets, and therefore comet changes should be closely connected with magnetic storms. This connection is supported by the evidence brought out in the present paper in a discussion of the behaviour of 31 comets scattered through the years 1848 to 1927. A general statistical result was that in the month preceding each comet's activity there occurred on the average 6, 4, 2·9 and 1·5 times as many magnetic storms of strength 4, 3, 2 and 1, respectively, as there should have occurred according to chance. Outstanding comet changes, 28 in number, were observed on the average 5 days after strong magnetic storms. The positions of the comet, sun and earth at the epochs of the comet changes indicated that the solar flare was in a wide angle, contrary to the narrow beam hypothesis of Maunder. AUTHORS.

284. Ultra-Violet Light Theory of Auroræ and Magnetic Storms. E. O. Hulburt. *Phys. Rev.* 34. *pp.* 344–351, *July* 15, 1929.

The ultra-violet light theory of auroræ and magnetic storms suggests: (1) that because of winds and unusual production of ions the ionised region of the high atmosphere may be in violent agitation during the day of a magnetic storm, that it grows calmer at night and becomes agitated the next day if the storm continues; (2) that there may be auroral displays in polar regions with no magnetic storms in temperate latitudes; (3) that auroral displays in temperate latitudes should as a rule be accompanied by magnetic storms; and (4) that polar auroræ should follow several hours or a day after strong magnetic disturbances observed in temperate latitudes. These inferences are shown to be in agreement with the data from magnetic observatories and observations of auroræ in temperate and polar latitudes. AUTHOR.

CURRENT ELECTRICITY, MAGNETISM AND ELECTRO-MAGNETISM.

285. Superconducting Metals. J. H. Bartlett. *Nature*, 123. *pp.* 869–871, *June* 8, 1929.

Bartlett objects to Kapitza's suggestion that superconductivity is a general phenomenon which can exist in all metals, but is marked by an additional resistance which does not disappear in most metals at low temperatures. He proposes a superconductivity model which gives a qualitative picture of most of the facts. The crystal is supposed to be composed of two systems, the lattice with its characteristic vibrations, and the electron system considering the lattice ions at rest. These can be treated by wave mechanics, and it can be assumed that in the superconducting state the lattice has not sufficient energy to impart it in the form of kinetic energy to the electrons, but that the latter may only change their magnetic energy. As a result there is little or no electrical resistance. **P. Kapitza,** in a letter written in reply, points out certain difficulties which arise in applying Bartlett's theory, which he considers a very interesting one, requiring to be worked out and tested by experiment; he fails to see how it can account for the suddenness with which superconductivity appears. Points out the differences between his own theory and that of Bartlett. H. N. A.

286. Temperature Dependence of Electrical Conductivity. W. V. Houston. *Phys. Rev.* 34. *pp.* 279–283, *July* 15, 1929.

To explain the fact that the resistance of a pure metal becomes zero at the absolute zero of temperature it is necessary to take into account the restrictions placed upon the electron scattering by the quantum statistics. When these are included as a probability of transition, the Brillouin treatment of wave scattering gives a very satisfactory law of the temperature dependence of resistance. AUTHOR.

287. Electrical Conductivity of Vapours of Salts. H. Querengässer. *Zeits. f. Elektrochem.* 35. *p.* 459, *July*, 1929.

The author gives a correction of his conclusion in a former paper [see Abstract 2817 (1929)]. From the latest investigations it appears that the results obtained by G. C. Schmidt and C. Sheard lead to the conclusion that at the low temperatures concerned the vapour is not dissociated and the conductivity is immeasurably small. J. J. S.

288. Calorimetric Absolute Measurement of the Electrolytic Conductivity for H.F. Alternating Currents. E. Justi. *Ann. d. Physik*, 2. 1. *pp.* 65–93, *June* 7, 1929.

Fischer and Wever's theory of inductive heating affords for the heating of metals, with certain limitations, relations numerically good. The surrounding of the metal with an insulator appears to cause an increase of the skin effect, which rises in value with the dielectric constant and the thickness of the coating of this medium. Conversely, the conclusion may be drawn that the increase of resistance which an insulated wire traversed by a high-frequency current exhibits in contra-distinction to an uncovered one may not be due to dielectric losses of the insulating material, but may even be produced by its high dielectric constant. In the region in which the heating of a body in a high-frequency oven is proportional to its conductivity the influence of the length of coil can be expressed by a constant factor. In the region of the frequencies of wireless telegraphy no change of the electrolytic conductivity of moderate order of magnitude appears which can be of decisive influence for the mode of action of underground and under-water antennæ. J. J. S.

289. Ratio of Electromagnetic to Electrostatic Unit of Electricity as Compared to Velocity of Light. H. L. Curtis. *Bureau of Standards, J. of Research*, 3. *pp.* 63–64, *July*, 1929.

The value of the ratio of the electrical units has been revised to meet the new values of the absolute determination of the ohm. This revised value is compared with the latest value of the velocity of light. AUTHOR.

290. Method of Determining the Ohm in Absolute Measure. M. Picard. *Comptes Rendus*, 189. *pp.* 125–126, *July* 17, 1929.

In Campbell's method of determining the ohm, certain resistances have to be evaluated which vary with frequency and temperature. The paper describes a method which overcomes the difficulty, and requires the measurement of a frequency, a self-inductance and a mutual inductance. [See Abstract 1731 (1925).] G. E. A

291. Tellurium Thermocouples. B. Lange and W. Heller. *Phys. Zeits.* 30. *pp.* 419–425, *July* 1, 1929.

The thermoelectric power of a tellurium-platinum couple (tellurium used as purchased) shows a linear increase of about 340×10^{-6} V per degree from 0° to 200°, at which point the rate decreases. These figures correspond to an approximately equal mixture of Te-α and Te-β [see Abstract 851 (1910)]. Such a couple, but with the tellurium quenched so as to give a thermoelectric power of about 400×10^{-6} V per degree, gives reproducible results and an accurately linear relation between such power and temperature between − 75° and + 90°, and is, therefore, sufficiently sensitive to be used within those limits for measuring temperature differences of the order of 0·01° with merely a needle galvanometer. Full details of construction and precautions necessary are given. Less satisfactory results were obtained with a copper-tellurium couple. The temperature coefficient of the resistance of tellurium is shown to be very nearly constant and 0·00325 ohm per degree between 0° and 40°. A rod 1 mm. in diameter and 5–10 cm. long has a resistance of about 1000 ohms, and thus shows a variation of more than 1 ohm per degree, which makes it suitable for use in a resistance thermometer. C. A. S.

292. Behaviour of Various Organic Vapours in the H.F. Glow Discharge. E. Hiedemann. *Ann. d. Physik,* 2. 2. *pp.* 221–232, *June* 28, 1929.

Experiments showed that the method of introducing hydrogen into a vacuum tube by means of a glowing palladium tube gives hydrogen of a high degree of purity even when the palladium tube is surrounded by an atmosphere containing, besides hydrogen, different vapours as impurities. Investigation of the discharge phenomena in vapours of ether, ethyl alcohol, acetone, acetic acid, chloroform, carbon tetrachloride and benzol in the high-frequency glow discharge showed that in all cases decomposition occurred. All the vapours gave a precipitate, which consisted either of carbon or a carbon compound of higher molecular weight. The discharge products in the case of benzol were found to consist of diphenyl, biphenylene and higher isomers. The kind of electric discharge appeared to have no influence on the products obtained, though the quantities depended on the current strength and potential gradient in the discharge tube. [See Abstract 2167 (1928).] A. W.

293. Mercury Arc with Thin Glass Window. S. Sonkin. *J.O.S.A. and R.S.I.* 19. *pp.* 65–67, *July,* 1929.

Thin pyrex windows (0·001 cm. thick) transmit in the ultra-violet as far as $\lambda 1854$, though not quite so well as fused quartz. It is suggested that arcs fitted with such pyrex windows should prove very useful in spectroscopic work. F. J. W.

294. Striations, Kathode Dark Space and Negative Glow in the Electric Discharge. J. J. Thomson. *Phil. Mag.* 8. *pp.* 1–29, *July,* 1929.

The average energy spent in producing an electron is $V_0 + \beta R$, where β is the number of inelastic resonance collisions and V_0 and R are the ionisation and resonance potentials respectively. It is shown that β will decrease as the energy of the electron increases, so that electrons can be produced more economically by fast electrons than by slow ones. The electric force acting on the ionising electron should be sufficient to raise its energy well above the ionisation potential initially, after which the force may decrease rapidly. Less energy will, therefore, be required to produce a given number of electrons in the striated discharge than in the uniform positive column. The striated discharge may, however, involve a greater loss of electrons by recombination and diffusion. It is suggested that a discharge is stratified or not according as the economy in producing a single electron is not or is overbalanced by the increased number of electrons that have to be produced. The basis of the explanation is that while increase in electronic energy increases the chance of an ionisation by collision, the chance of a resonance collision reaches a sharp maximum. This principle is applied to the consideration of phenomena which take place in the kathode dark space and the negative glow. F. J. W.

295. Discharge Tube Phenomena. R. Whiddington. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 467–473, *July,* 1929.

Further information is given relating to the positive flash in discharge tubes. The experiments have been carried out using argon as a filling gas. It appears that the positive flash consists of a series of narrow flashes moving down the tube. It is found that the product of the pressure and velocity is constant. The velocity is influenced to a slight extent by potential difference and current. Increase of 50 % in the current strength is accompanied by an increase of 10 % in velocity. In addition, however, there are discontinuous changes in velocity associated with more or less definite current strengths. Further investigation shows that there are at least five states of the discharge. Given in order of their appearance with increasing current density, they are (i) first slow flashes, (ii) first fast flashes, (iii) second slow flashes, (iv) second fast flashes, and (v) continuous positive column. The above data refer to types (ii) and (iii). The transition of type (ii) to type (iii) has been studied taking oscillograph measurements of tube current over the range. F. J. W.

296. "Reversal-like Phenomena" of Discharge Figures Impressed on Photographic Plates. T. Terada. *Kyoto Coll. Sci., Mem.* 12. *pp.* 217–222, *July,* 1929. *In English.*

The "reversal-like phenomena" of the discharge figures on photographic plates, which are produced by illuminating the plate with a spark light simultaneously with the impression of the discharge figure, are examined in the present experiment. The discharge figures giving rise to the phenomenon are similar to dust figures, and it seems to the writer that the ions produced on the sensitive film of the plate have an important bearing on this phenomenon. [See also Abstract 573 (1929).] AUTHOR.

297. Single Crystal Kathodes. K. G. Emeléus and Jean W. Beck. *Phil. Mag.* 8. *pp.* 121–125, *July,* 1929.

There is some evidence that the work function of a single crystal changes from one face to another, and it might be anticipated that the discharge phenomena would be different if single crystal kathodes were used instead of the ordinary polycrystalline pieces of metal. Experimenting with a single crystal (pyrites), however, the authors find that it behaves like an ordinary piece of polycrystalline metal in the glow discharge when used as a kathode. From the value of the normal kathode fall in potential in various gases, the work function of pyrites for electrons is calculated to be 4·8 volts. [See also Abstract 1628 (1929).] T. B.

298. Discharge at Atmospheric Pressure. M. Melcion. *Comptes Rendus*, 189. *pp.* 112–114, *July* 8, 1929.

Toepler and Kaufmann have observed between electrodes of very high resistivity, at atmospheric pressure, discharges whose appearance resembles that of low-pressure discharges. A study was made of similar discharges between bits of platinum wire projecting through the sealed ends of long glass tubes, the discharge circuit containing a resistance of about 100 megohms. The discharge, in the form of anode column and kathode glow separated by a dark space, is obtained for all electrode distances below 3 mm. If the air is damp similar effects are observed up to about 10 mm. Measurements of the breakdown potential gave values of 5500 volts at 2 mm. to 7800 volts at 5 mm. For electrode distances greater than 3 mm. the above type of discharge lasted only for a short time, changing to one more like a brush discharge. A. W.

299. Corona Discharge in Neon. L. G. H. Huxley. *Phil. Mag.* 8. *pp.* 128–129, *July*, 1929.

Penning [see Abstract 2562 (1929)] recently remarked that he obtained results with a simple apparatus which were not in agreement with results by the author [see Abstract 1959 (1928)], and concluded that the gas used by the latter was impure. The present author describes the careful methods which he used for getting rid of impurities, and his tests for their elimination. He points out that his preliminary results, *i.e.*, those obtained before purifying his gases, appear to be more consistent with Penning's observations, and suggests that in the latter's experiments impurities would tend to collect in the apparatus, and that it would be impossible to estimate what effect this might have on the potentials required to produce discharges. T. B.

300. Passage of Slow Kathode Rays through Metals. A. Becker. *Ann. d. Physik*, 2. 3. *pp.* 249–263, *July* 15, 1929.

Investigation has been confined to electrons of velocity between 100 and 0·5 volts and nickel foil of about 0·02 and 0·04 μ in thickness. The permeability-velocity curve rises sharply between 2 and 10 volts, but at higher voltages the rate of increase of permeability is much less. The curve flattens out considerably between 10 and 100 volts to an approximate straight line. Over this linear portion there are two points at which the increase of permeability with velocity is anomalous. At between 10 and 20 volts on the 0·04 μ foil the permeability is constant and at 70 volts a minimum is observed. These are attributed to selective permeability. The loss in intensity of kathode rays due to nickel foil is caused almost entirely by reflection; true absorption accounts only for a very small fraction of the loss. Scattering of the electrons by the foil occurs preferentially in certain directions. [See also Abstract 710 (1928).] F. J. W.

301. Atomic Rays of Hydrogen. Part I. Technical Production and Action on the Schumann Plate. H. Kerschbaum. *Ann. d. Physik*, 2. 2. *pp.* 201–220, *June* 28, 1929.

Hydrogen atoms from a Wood's tube passed into a side piece, and through three celluloid slits or holes arranged in line, on to a Schumann plate contained in a receiver in which the pressure was kept exceedingly low. Very little light from the Wood's tube reached the plate, and it was

V.3
193

possible to discriminate between the photographic effect of this and the blackening caused by the impact of the atomic rays of hydrogen. Reflection experiments were made on the rays, the velocity of which was that due to the thermal movements of the gas. Mica, gypsum and celluloid were used as reflectors, with angles of incidence between 45° and 50° and between 5° and 10°. The angle of reflection was equal to the angle of incidence. When the beam of hydrogen atoms was passed through very thin foils of celluloid or mica, the photographic impression on the Schumann plate showed only an irregular scattering in the foil, with no signs of a diffraction pattern. Experiments were made on the scattering of the beam in neon at measured pressures. H. N .A.

302. Critical Potentials and Low-Tension Arcs in Hydrogen. **S. Vencov.** *Comptes Rendus*, 189. *pp.* 27–30, *July* 1, 1929.

Observations were made by the method of electronic bombardment, and the ionisation currents were plotted against the accelerating voltage. The following critical potentials were obtained:—11·5 ± 0·5 volts (resonance of the molecule); 13·6 ± 0·2 volts (atomic ionisation, atomic hydrogen was produced by thermal dissociation of H_2 due to the incandescent filament); 16·5 ± 0·5 volts (dissociation of the molecule with a notable increase of the ionisation); 29·7 ± 0·6 volts (dissociation followed by double ionisation). Other critical potentials were obtained from time to time, but are not considered. The author deduces that the energy of dissociation of the hydrogen molecule corresponds to about 3 volts, which agrees with electrochemical determinations. The critical potential at 11·5 volts agrees with Witmer's theoretical determination, and with the value deduced from the analysis of the ultra-violet bands. The behaviour of the low-tension arc, which gives a very stable bluish-white light at 16·5 volts, is described for different voltages. H. N. A.

303. Doppler Effect in Homogeneous Hydrogen Canal Rays. **W. Riezler.** *Ann. d. Physik*, 2. 4. *pp.* 429–444, *July* 26, 1929.

The Doppler effect was measured for homogeneous canal rays, and it was found that the velocity calculated from this effect agreed with the velocity deduced from the deflection by an electric or magnetic field. Behind the kathode the charged canal ray particles are actually composed of H^+, H_2^+, H_3^+. These particles on their further path may become neutralised or decomposed, and then as neutral H particles send out the Balmer lines. If all Doppler lines which were found for the separate (homogeneous) regions cut out of a magnetic spectrum are superposed, a distribution is obtained which approximately agrees with the Doppler distribution found by Krefft in unhomogeneous radiation. J. J. S.

304. Reunion of Positive Ions with Free Electrons. **R. Seeliger.** *Phys. Zeits.* 30. *pp.* 329–357, *June* 1, 1929.

A general review of the subject. When free electrons with all possible small relative velocities combine with the ions a continuous spectrum is to be expected following the series-line spectrum on the short wave-length side, and such series-limit continuous spectra have been observed in tubes of different forms. The continued emission of light by gas which has been withdrawn from the discharge space is also connected with the reunion of electrons and ions, and details are given. Certain observations of series-limit continua in cosmic sources of light are mentioned. The effects of reunion have been observed in the negative glow and in canal rays, but there is very little of such effect in the positive column. Kathode rays and the swift electrons appear to give no effect. Atkinson's attempt to measure the reunion by sending a beam of ions through a cloud of electrons is mentioned. The paper concludes with a theoretical treatment of the subject; the theory of Milne and Becker on equilibrium of radiation is dealt with, and a formula is obtained for the frequency of reunion of electrons and ions. Kramers, Eddington and Rüchardt have also contributed to the theory, which has been applied in astrophysical calculations. H. N. A.

305. Ionisation by Collision in Monatomic Gases. J. S. Townsend and S. P. MacCallum. *Roy. Soc., Proc.* **124.** *pp.* **533–545,** *July* 1, 1929.

Detailed criticism is given of certain theories of ionisation which have recently been advanced by Atkinson [see Abstracts 2805 (1928) and 1957 (1929)]. Many reasons are given for concluding that any hypotheses such as those involved in one theory of ionisation put forward by Atkinson are untenable, and the authors can find no definite experimental evidence in support of the principles on which the theory is based. A. W.

306. Distribution of Mobilities of Ions in Moist Air. J. Zeleny. *Phys. Rev.* **34.** *pp.* 310–334, *July* 15, 1929.

No distinct groups of ions having different mobilities in undried air were found among ions two or more seconds after their formation, during a critical study upon the effects of diffusion upon the distribution of ions moving in an electric field. Experimental results obtained for N, the volume density of ions which after a time t are located at a distance r from the origin, agree fairly well with the theoretical formula $\mathrm{N}=\mathrm{N}_0 e^{-\frac{r^2}{4\mathrm{D}t}}/(4\pi\mathrm{D}t)^{\frac{3}{2}}$, where D is the coefficient of diffusion. The mobilities and the spreading of the ions were measured by a modification of the author's method, in which ions passing between two concentric cylinders under an electric field are simultaneously carried axially by a slow, non-turbulent current of air of known velocity. The ions entered the air stream through small openings in the walls of the outer cylinder, and their distribution at the central cylinder was measured by catching them on a narrow, insulated section of that cylinder which was connected to an electrometer. The distribution in one group would be explained if a number of unresolved permanent distinct groups exist, but a more probable explanation rests on the assumption that the ions are clusters which change in size under the influence of molecular bombardment, the life of each stage being sufficiently long so that the number of changes occurring during the time of passage of the ions is not very great. Without weighting the observations, the average mobility found for the negative ions is 2·00 cm./sec. volt/cm. for an average water content of 3·2 mg. per litre of air, and the average for the positive ions is 1·22 cm./sec. volt/cm. for an average water content of 2·7 mg. per litre of air. H. H. Ho.

307. Positive Ray Analysis and its Application to the Measurement of Ionisation Potentials in Mercury Vapour. W. Bleakney. *Phys. Rev.* **34.** *pp.* 157–160, *July* 1, 1929.

A new method of positive ray analysis is described which lends itself particularly well to the study of the nature of the ions formed by single electron impact in gases, the efficiency of their production, and the measurement of ther ionisation potentials. The novel feature of the method is the use of the uniform magnetic field or a large solenoid so to concentrate a beam of electrons as to provide a linear source of positive ions. The ions are then pulled across the magnetic field and subjected to an e/m analysis by a suitably designed analyser. Some preliminary results are given for mercury vapour in which the ionisation potentials of Hg^{2+}, Hg^{3+} and Hg^{4+} are found at 30, 71, and 143 volts respectively. AUTHOR.

308. Emission of Electrons from Cold Metals. T. E. Stern, B. S. Gossling and R. H. Fowler. *Roy. Soc., Proc.* 124. *pp.* 699–723, *July* 1, 1929.

An extension of the theory of the emission of electrons from cold metals under the effect of an intense electric field is discussed. In particular detailed examinations are given of (i) the space charge effect, and (ii) the effect of surface films on the emission coefficient. Existing experimental data are discussed and an account is given of experiments by the authors and other investigators the results of which support the improved theory. J. J. S.

309. Emission of Electrons from Metals Subjected to X-Radiation. W. Espe. *Ann. d. Physik,* 2. 4. *pp.* 381–426, *July* 26, 1929.

Unlike the photoelectric effect with visible radiation, the emission of electrons by X-radiation results in the emission of electrons from the actual atoms. Previous work in this connection is reviewed. The methods of investigation are then discussed and the apparatus used is minutely described and illustrated. The practical results are considered in relation to the theoretical results and a somewhat complicated formula derived (which embraces previous formulæ due to Shearer and Berg and Ellinger) for computation of the number of electrons emitted with the X-ray beam incident below a defined angle ϕ. The dependence of the emission on the angle of incidence is derived for electrons having maximal and minimal velocities. The law is exactly obeyed by rapid electrons, but, in practice, for slow electrons, it is greater than shown by theory, the difference being capable of explanation. The emission as regards quantity is dependent upon the roughness of the irradiated surface, and is smallest for highly polished surfaces, and increases with the increase of irregularity of the surface. Conversely, the emission of rapid electrons is slightly decreased.

The dependence of the emission upon the ordinate number of the metal is investigated, and rises proportionally to the ordinate number until a discontinuity results owing to the frequency of the radiation reaching and exceeding the characteristic frequency of the metal. The relation of emission to wave-length is investigated. Differences from the Einstein law are due to variation of absorption with wave-length. The emission is strictly proportional to the intensity of radiation and thereby to the voltage applied to the X-ray tube. For iron, nickel and copper antikathodes the variation is greater than linear and varies as the third power of the potential and, therefore, as the emission of X-rays. Finally, it is shown that there is no increase of emission from palladium which contains occluded hydrogen, as in the case of the visible radiation photoelectric effect. B. J. L.

310. Thermionic Emission from Metals. E. H. Hall. *Nat. Acad. Sci., Proc.* 15. *pp.* 504–514, *June*, 1929.

The author continues his support of the thesis that all the known facts regarding thermionic emission from metals are consistent with the original conception of Richardson which assumed the emitted electrons to come from a body of free electrons sharing the energy of thermal agitation within the metal. While revising some remarks concerning the equality of " A " in different metals, and considering the possibility that the photoelectric work function represented by " b_0 " is variable with temperature, the author argues that all the evidence, both experimental and thermodynamical, is consistent with the thesis that electric conduction in metals is carried on by electrons in two different states, the " free " electrons or " thermions "—those issuing in thermionic emission, and the " associated " or " valence " electrons—those expelled in photoelectric action.

J. J. S.

311. Emission of Anode Rays of Sodium and Chromium. A. Poirot. *Comptes Rendus*, 189. *pp.* 150–151, July 22, 1929.

Morand's method [see Abstract 2130 (1927)] is applied to sodium bichromate, yielding an emission of anode rays of chromium and sodium of great stability and longer duration than for lithium. Emission begins suddenly below the melting point of the salt. Once started the potential difference falls rapidly to a few thousand volts, thereafter remaining constant. The light at the kathode shows the arc spectra of sodium and chromium, that at the anode of chromium only, nothing attributable to oxygen is apparent anywhere. By careful regulation of conditions good results are obtainable by this method with non-halogen salts and with the heavy metals.

C. A. S.

312. Layers of Cæsium and Nitrogen on Tungsten. N. A. de Bruyne. *Cambridge Phil. Soc., Proc.* 25. *pp.* 347–354, *July*, 1929.

Investigates the effect of a cæsium film on the auto-electronic emission from a tungsten surface in an atmosphere of nitrogen. The increase observed must be due to cæsium. The function of the activated nitrogen is thus probably to hold the cæsium atoms to the surface at a temperature above that at which a cæsium atom alone can adhere. This explanation is in agreement with the fact that when the secondary peak has been formed the primary peak cannot attain its maximum value, since part of the surface is already occupied by the molecules of (cæsium + nitrogen). It was observed that however long the formation of the secondary peak was carried on, it was always possible to obtain a primary peak subsequently. This suggests that when the surface is full up with (cæsium + nitrogen) molecules there is still room for cæsium atoms on the surface.

E. E. F. d'A.

313. Photo-Ionisation of Cæsium and Rubidium Vapours. E. O. Lawrence and N. E. Edlefsen. *Phys. Rev.* 34. *pp.* 233–242, *July* 15, 1929.

A modification of Foote and Mohler's space charge method for the measurement of photo-ionisation was devised which compensated out spurious effects due to fluctuations of temperature and increased the useful sensitivity of the space charge to positive ions about one hundredfold. By measuring simultaneously photo-ionisation and light intensities certain results have been obtained. The continuous absorption resulting in ionisation decreases with wave-length much more rapidly than the analogous absorption beyond the Lyman and Balmer series limits as calculated on the wave mechanics by Sugiura, Oppenheimer and Reiche. The results, moreover, are not even qualitatively similar to Hargreaves' calculation of the variation with frequency of B_γ for lithium. Assuming the principle of detailed balance, it follows from these experiments that the effective collision-capture cross-sections of cæsium and rubidium ions for electrons vary inversely as the square of the energy of the electrons relative to the ions. This is the Thomson recombination law, and has been derived by wave mechanics by Oppenheimer for the recombination of protons and electrons. The existence of photo-ionisation by absorption of principal series lines in cæsium, so clearly exhibited by Mohler, Foote and Chenault, has been confirmed and also has been observed in rubidium.

E. E. F. d'A.

314. Production of Emission from Oxide Coated Filaments. V. C. Macnabb. *J.O.S.A. and R.S.I.* 19. *pp.* 33–41, *July*, 1929.

The production of oxide filaments of barium and strontium in an emitting condition is investigated from the standpoint of determining the advantages of several apparently different methods of producing this type of kathode as used by several different companies. It is found that all methods amount to the same thing and are different only in degree. The fundamental underlying action of all methods is that the filament to become emissive must undergo a gaseous bombardment, which presumably causes a breaking down of the higher oxides or compounds, as the carbonate, to the lower oxides or pure metal, and, conversely, this breaking down must be caused by or accompanied by a gaseous discharge in order to produce an active filament. The gas most suitable for this action is best obtained from the filament and is best produced from a carbonate that has not been reduced until put *in vacuo*, and that the gas then liberated and used is probably CO_2. These conclusions are arrived at by experiments on several different types of filaments containing relatively different amounts of combined or baked-on coating to uncombined coating, and in every case results favour those filaments containing most uncombined coating. Some secondary conclusions are that the baked-on coating serves little or no purpose except as a mechanical bond, and that the core material on which the coating can be placed may be of a wide variety of material.

AUTHOR.

315. Photoelectric Long-Wave Limit of the Alkali Metals. H. E. Ives and A. R. Olpin. *Phys. Rev.* 34. *pp.* 117–128, *July* 1, 1929.

Earlier experiments have shown that the long-wave limit of photoelectric action in the case of thin films of the alkali metals varies with the thickness of the film. A maximum value is attained greater than that for the metal in bulk, which for the majority of the alkali metals lies in the infra-red. The wave-length of the maximum excursion of the long-wave limit was first studied for Na, K, Rb and Cs. In each case it was found to coincide with the first line of the principal series, *i.e.*, the resonance potential. If this relation holds for lithium, its maximum long-wave limit should be greater than that of sodium. This was tested and confirmed by experiments in which red-sensitive lithium films were prepared, sensitive to $0\cdot6708\ \mu$. It is suggested that photoelectric emission is caused when sufficient energy is given to the atom, to produce its first stage of excitation. The identity of photoelectric and thermionic work functions suggests that atomic excitation is the initial process in thermionic emission as well. AUTHORS.

316. Photoelectric and Thermionic Emission from Cobalt. A. B. Cardwell. *Nat. Acad. Sci., Proc.* 15. *pp.* 544–550, *July*, 1929.

In view of the discovery of a sudden change of the photoelectric and thermionic emission from iron at the A_3 point where the body-centred lattice is translated into a face-centred cube, the study was extended to cobalt, which was thoroughly outgassed by a process of baking continued for 400 hours. The photoelectric emission showed great complexity, and no definite conclusions are drawn. It seems reasonable to conclude, however, that the photoelectric and thermionic functions are identical, and that the increased photoelectric sensitiveness of cobalt above the transition point must be the direct result of a change in the surface work function. E. E. F. d'A.

317. Photoelectric Threshold of a Doubly Evaporated Film. R. B. Jones. *Phys. Rev.* 34. *pp.* 227–232, *July* 15, 1929.

A method is described whereby a platinum, a nickel, and a "double" platinum-nickel film were obtained by evaporation, simultaneously and under the same conditions. The threshold wave-lengths were first found from saturation photoelectric currents obtained with monochromatic light of different wave-lengths. These values, which were confirmed and determined more precisely by retarding-potential, photo-current curves, are for Ni 3333 Å., for Pt 2804 Å. and for the double Ni-Pt 3318 Å. A similar investigation with tungsten and platinum gave the thresholds of the Pt and the double Pt-W film at 2831 Å. and 2804 Å. respectively, almost 500 Å. above the threshold of W, which was 2338 Å. The threshold of each double film is, therefore, practically the threshold of the constituent which, when pure, has the longer wave-length threshold. AUTHOR.

318. Photoelectric Properties of Salts. J. Werner. *Zeits. f. Physik*, 57. 3–4. *pp.* 192–226, 1929.

CdI_2, $PbCl_2$ and KNO_3 show marked fatigue effects with time due to escape of electrons from the surface. A rest or the application of a pulling field leads to an increase in the sensitivity. The cause of this is discussed. The sensitivity decreases as the sample is degassed, falling to zero when it is completely degassed. The sensitivity is, moreover, not increased when the degassed sample is treated with dry gas. J. E.

319. Talbot's Law in Photoelectric Cells. N. Campbell. *Phil. Mag.* 8. *pp.* 63–64, *July*, 1929.

An alternative explanation is given for the variation of the emission in the photoelectric cell by assuming that there is no appreciable change of emission during a cycle, if the whole of the change takes place in the much longer period during which the instrument is taking up its final reading, and if the amount of the change is determined wholly by the time average of the illumination. It is suggested also that the emission may fail by the illumination raising the potential of the gas-filled cell near to sparking potential. [See Abstract 3548 (1929) and the following Abstract.] R. S. R.

320. Talbot's Law in Photoelectric Cells. T. H. Harrison and W. S. Stiles. *Phil. Mag.* 8. *pp.* 64–65, *July*, 1929.

The authors suggest that Campbell's explanation [see preceding Abstract] does not conflict with their own, but that, although the change of emission during a light period is small, the rate of change with time is significant. It is considered that for high sector speeds the arc discharge does not have time to develop, but for photometric measurements it is inadvisable to use a cell near the arcing point. In gas-filled cells there is some ionisation due to collisions, but even at the lowest sector speeds used Talbot's Law was obeyed. R. S. R.

321. Analysis of Electronic Velocities by Electrostatic Means. A. L. Hughes and V. Rojansky. *Phys. Rev.* 34. *pp.* 284–290, *July* 15, 1929.

Since in certain types of experiments it is convenient to use electrostatic rather than magnetic fields, the analysing possibilities of radial inverse first-power electrostatic fields have been investigated. It is shown that such fields, under suitable conditions, are almost as effective as magnetic fields. The plane of the receiving slit should be placed at an angle of 127° 17′ to the plane of the entrance slit. The resolution at this angle of two electrons of velocities V and v both entering normally to the plane of the entrance slit is $d_e = (2\beta - 4\beta^2)r_0$, where $\beta = V - v/V$ and r_0 is the radius of the circular path in which an electron of velocity V will travel. The "departure from perfect refocussing" at this angle of two electrons of velocity V, one entering normally to the plane of the entrance slit and the other at an angle α to the normal, is $s_e = \alpha^2 r_0$. [See also next Abstract.] F. J. W.

322. Refocussing of Electron Paths in a Radial Electrostatic Field. A. L. Hughes and J. H. McMillen. *Phys. Rev.* 34. *pp.* 291–295, *July* 15, 1929.

The theoretical treatment of the analysis of electronic velocities by a radial-inverse first-power electrostatic field has been tested experimentally [see preceding Abstract]. The refocussing and resolution predicted when the plane of the receiving slit is at an angle of 127° 17′ to the plane of the entrance slit have been found satisfactory. F. J. W.

323. Ionic Rays. M. Zentgraf. *Ann. d. Physik*, 2. 3. *pp.* 313–333, *July* 15, 1929.

Experiments are described amplifying the work of Schmidt [see Abstract 98 (1925)], whose experiments were, in general, made at only a single temperature and pressure. The following results were obtained. Besides the ordinary time effects of the emission, time variations were found due to impoverishment and subsequent recovery of the surface of the material. The impoverishment is greater the higher the applied potential and the lower the temperature. Recovery is the more rapid the smaller the applied potential and the higher the temperature. Saturation occurs at low pressures with very small potentials, and the potential at which saturation occurs rises with the pressure. At low temperatures saturation is much more pronounced than at high temperatures and occurs at lower potentials. Saturation effects are particularly marked with salts having a low vapour pressure, the silver halogen salts showing the effects better than thallium salts and CdI_2. The curves showing the relation between e.m.f. and emission, however, are never quite parallel to the axis of abscissæ.

The commencement of the emission depends on the pressure. At low pressures the first ions are given off at lower potentials than at higher pressures. Luminous discharges were observed in all cases at 300–400 volts for a pressure of 1 mm., 600–800 volts for 10-mm. pressure, and 1600–2000 volts for 100-mm. pressure. In a high vacuum luminous discharges were never observed at voltages up to 1900 volts. In a second experimental arrangement, where the whole cell was heated and the cell filled with the vapour of the salt, very much greater currents were obtained than in the first type of apparatus, and saturation was only obtained at low pressures when the salt vapour was being rapidly pumped away. A. W.

324. Magnetic Deflection of Corpuscular Rays according to Dirac's Wave Mechanics. W. Alexandrow. *Ann. d. Physik*, 2. 4. *pp.* 477–484, *July* 26, 1929.

The solution of Dirac's wave equations for the electron enable a scalar, probability density, and a vector, probability current, to be determined. Defining probability-current velocity as the ratio of the length of the probability-current vector, to the probability density, this velocity is found to satisfy the de Broglie relation between the velocity of a particle and the wave-length of its material wave. Further, in the case of a magnetic field, the solution of Dirac's equations shows that the probability-current field lines are circles in planes perpendicular to the direction of the magnetic force. In each such circle the probability-current velocity satisfies

$$\frac{mv^2}{r}\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}=\frac{eHv}{c},$$

which is simply the usual mechanical equation of motion (corrected for relativity) applicable to a particle of mass m, charge e, velocity v, moving in a magnetic field H. The investigation shows that the field lines of the probability current correspond to the usual conception of the " path " of the particles. W. S. S.

325. Absorption of Hertzian Waves in Ionised Gases. H. Dänzer. *Ann. d. Physik*, 2. 1. *pp.* 27–62, *June* 7, 1929.

A description is given of a new and sensitive receiver for Hertzian waves which operates on the bolometer principle. By means of this receiver the absorption and reflection of Hertzian waves of about 4 cm. wave-length was investigated for highly ionised gases. The gases used were neon, argon, nitrogen, hydrogen, oxygen, and air. The results obtained for the absorption of these short waves were used to measure the life of the free electrons occurring in discharges through these gases. Theory is given, and the experimental results are shown to be in agreement with those to be expected on theoretical grounds. A. W.

326. Influence of an Inductively-Coupled Indicating Apparatus on Standing Electrical Waves in Wires. W. Kessenich. *Ann. d. Physik*, 2. 4. *pp.* 445–464, *July* 26, 1929.

A Busch wave-indicator was employed to study the standing waves in parallel Lecher wires. It was found that under ordinary conditions the influence of the indicator and of the damping of the Lecher system did not produce any marked asymmetry in the resonance curves. The asymmetry which remains even when the immediate effect of the working of the generator is removed is due to a secondary field, which is transmitted along the Lecher wires, and compounds with the ordinary standing waves. The nature of this field requires further investigation; it can be removed by suitable alteration in the coupling. H. N. A.

327. Application of Whiddington Ultra-Micrometer. H. Lloyd. *Journ. Sci. Instruments,* 6. *pp.* 81–84, *March,* 1929.

A description of a method adopted to overcome some of the difficulties met with in the use of the heterodyne micrometer, and improved arrangements for the indication of zero-beat condition audibly or visibly. The method is applied to the measurement of the magnetostrictive properties of small samples only 5 cm. in length. A notable feature of the apparatus is the acoustic coupling devised to communicate the vibrations of the detector microphone to the earphones. This consists of a glass tube fastened to the microphone of the detector along which the sound is conveyed to another microphone attached to the earphones in the ordinary way. A further method is described enabling the vibrations to be optically recorded. S. G. B.

328. Measurement of Joule Magnetostrictive Effect in a Cold Drawn Wire. J. H. Handley. *Journ. Sci. Instruments,* 6. *pp.* 84–88, March, 1929.

For cold worked specimens of an annealed or thin wire the change in length on magnetisation can only be satisfactorily measured by an electromagnetic method. The changes in length in the wire are made to cause variations in the capacity of a condenser in an oscillatory circuit. The efficiency of the present method lies in the mounting of the condenser system so as to reduce mechanical vibrations and spurious electromagnetic disturbances to a minimum. To accomplish this both plates of the condenser were supported by the same body, a heavy slate yoke. The inertia of the system was great, and the solenoid was mounted independently of the rest of the apparatus. Lloyd's method of measurement of changes in capacity was used [see following Abstract]. To eliminate the trouble due to viscosity of the paraffin and the temperature effects the solenoid was wound with two layers of wire of equal number of turns, which could be put in opposition or in conjunction by means of a six-pole switch. The advantages claimed for the method are: (*a*) elimination of vibration; (*b*) elimination of temperature variations; (*c*) shorter time to assume steady conditions, *viz.*, about 15 minutes; (*d*) the "cup" arrangement of the condenser reduces non-axial effects of the wire to a minimum; (*e*) the load required to keep the wire in position is comparatively negligible; (*f*) the magnetic field can be measured to high accuracy if desired. It was shown that cold work diminishes the maximum elongation of steel wires, a confirmation of the work of Williams and More. S. G. B.

329. Magnetostriction and Allied Phenomena. J. H. Vincent. *Journ. of Sci. Instruments,* 6. *pp.* 89–90, *March,* 1929.

Suggestions for the development of the method of Lloyd and Handley [see the two preceding Abstracts] for the detection of other magnetostrictive effects. Schulze states that a liquid shows a minute Barrett effect, and it is suggested that the Lloyd and Handley method could be utilised to investigate this, since if its volume changed its specific inductive capacity would change. It is further suggested that it may be possible with the ultramicrometer to detect the Joule effect in substances such as glass, if the phenomena observed are genuine magnetostrictive oscillations.

S. G. B.

330. Homogeneity of Magnetic Field in Helmholtz-Gaugain Arrangement of Double Circuits. R. Bock. *Zeits. f. Physik*, 54. 3–4. *pp*. 257–259, 1929.

For the production of a homogeneous magnetic field the double-circuit arrangement of Helmholtz and Gaugain is frequently used. Its chief characteristic is two circular conductors of the same radius, with their centre points on the same axis, distant from one another by a space equal to their radius, through which the same current flows. By means of spherical functions the present work evaluates the absolute strength of the magnetic field in such an arrangement. The work is theoretical throughout. The results are tabulated for different radii, etc. S. G. B.

331. Production of Homogeneous Magnetic Fields by Circular Current Circuits. G. Fanselau. *Zeits. f. Physik*, 54. 3–4. *pp*. 260–269, 1929.

A mathematical discussion of the conditions necessary for the precise arrangement of circular current circuits for the production of homogeneous magnetic fields. In comparison with the known Helmholtz coils an arrangement is discussed which should exhibit a considerable improvement, and the use of this new arrangement is suggested and investigated for the determination of the strength of the earth's magnetism. The results are given in tabular form for the suggested method. S. G. B.

332. Magnetisation Diagram for Iron Crystals. G. J. Sizoo. *Zeits. f. Physik*, 56. 9–10. *pp*. 649–670, 1929.

Measurements were made on a number of iron crystals with large form-factor. The material was crystallised from pure electrolytic iron, and crystals from 10 to 15 cm. long were obtained. The orientations of the axes were determined, and the crystals were tested by magnetometer and, in some cases, ballistically. The observations lead to the conclusion that the true magnetisation curve contains kinks; hysteresis was present in all cases, but only in the region of small fields. Above the last kink, the magnetisation is reversible. The remanence is of the same order as in polycrystalline material, and is very probably a function of the orientation. [See also Abstract 3312 (1928).] G. E. A.

333. Magnetic Moment of the Quadripole of the Iron Atom. N. S. Akulov. *Zeits. f. Physik*, 57. 3–4. *pp*. 249–256, 1929.

The internal magnetic energy density of the iron monocrystal may be represented as the sum of the densities of the dipole and the quadripole. The moment of the quadripole is determined by two methods, namely from the area of the curves relating field direction with the component of magnetisation parallel to the field, and from the course of the magnetisation curves for the component normal to the field. The energy densities of the dipole of the body-centred lattice and of the quadripole are evaluated. [See also Abstract 2831 (1929).] G. E. A.

334. Magnetic Investigations of Adsorbed Gases. J. Aharoni and F. Simon. *Zeits. f. phys. Chem.* 4. *Abt. B*. 3. *pp*. 175–189, *July*, 1929.

In this paper a simple null method is described for the exact measurement of magnetic susceptibilities, which may be worked without knowledge of the field strength and is especially suitable for low temperatures. The systems chabasite-oxygen, charcoal-oxygen and palladium-hydrogen have been measured by this method at different gas concentrations and temperatures, and also the ammonium halides, manganese oxide and manganese peroxide. The susceptibility of oxygen adsorbed by chabasite is smaller than that of the free gas and changes discontinuously at integral molecular ratios; similarly, for the system charcoal-oxygen. The data for the system palladium-hydrogen are explained on the assumption of the presence of a compound Pd_2H, which is feebly paramagnetic, the residual hydrogen being adsorptively bound. Anomalies of ammonium salts at − 30° to − 40° C. are not magnetically discernible, and are of similar magnitude to those of MnO and MnO_2. H. H. Ho.

335. Saturation of Electric and Magnetic Polarisation of Gases in Quantum Mechanics. K. F. Niessen. *Phys. Rev.* 34. *pp.* 253–278, *July* 15, 1929.

In this paper the calculations of dielectric and magnetic susceptibility in quantum mechanics previously made by van Vleck are extended to include higher powers of the field strength. This is necessary in fields so strong that the moment is not linear in the field strength. As noted by Debye, the electric polarisation of a gas results from two effects: (*a*) a change in the spatial orientation of the rigid or permanent moment of the molecule; (*b*) the inducing of an elastic polarisation or deformation of the molecule. The effect of (*a*) is calculated to all powers of the field strength and yields exactly the classical Langevin function $L(\mu, F, T) = \mu [\cot gh(\mu F/kT) - kT/\mu F]$, provided only the (rotational) energy changes in "allowed" transitions are small compared to kT; μ is the permanent moment of the molecule. The part of the moment resulting from (*b*) and the part arising from the superposition of (*a*) and (*b*) is calculated to terms of the third order in the field F. The complete formula for the moment is to this order: $m_F = (\mu^2/3kT + p_0)F + (q_0 + q_1/kT + q_2/k^2T^2 - \mu^4/45k^3T^3)F^3$, where p_0, q_0, q_1, q_2 are constants whose explicit expressions in terms of the individual matrix elements are rather complicated. This expression is of the same type-form as that of Debye, except for addition of the term q_0, and reduces identically to his type-form if, following Debye, the model is specialised by the assumption of simple harmonic restoring forces. Brillouin has shown that if "spin" be neglected, the magnetic polarisation per atom in a monatomic gas is

$$m_H = \beta\left[\frac{l e^{l\beta H/kT} + (l+1)e^{-(l+1)\beta H/kT}}{e^{l\beta H/kT} - e^{-(l+1)\beta H/kT}} - \frac{1}{e^{\beta H/kT} - 1}\right] = \beta(l, \beta, H, T),$$

where $l + 1$ is the azimuthal quantum number of the old quantum theory and β the Bohr magneton, and this function is now shown to differ from that of Langevin because the various Cartesian components of the angular momentum matrix do not commute in multiplication, a complication not found in the electric case. The appearance of this Brillouin function (which is expressible as the difference of two Langevin functions) obviates Debye's objection that the classical Langevin theory yields infinite entropy at T = 0 in contradiction to the Nernst heat theorem. When "spin" is included two limiting cases are considered, and the paper concludes with a discussion of the magnetic polarisation of diatomic gases. H. H. Ho.

336. Magnetic Behaviour of Some Organic Crystals. S. Bhagavantam. *Indian Journ. Phys.* 4. *pp.* 1–14, *July*, 1929.

A small crystal is attached to the lower end of a vertical glass fibre, which is, in turn, fastened to a horizontal quartz fibre stretched parallel to the field. On applying a non-homogeneous magnetic field to the crystal, the latter moves across the field, and the susceptibility of the crystal for the particular orientation is found from the motion of the upper end of the fibre observed by a microscope. A table of results contains the ratios of the principal susceptibilities and the principal optical refractive indices of eight organic crystals. Magnetic anisotropy is found to be high in aromatics and feeble in aliphatics. The crystals are grouped in two classes: in the first, there is coincidence of the axes of maximum optical moment and maximum diamagnetic susceptibility; in the second, these axes intersect. In their chemical nature the two classes are similar to those liquids which exhibit respectively negative and positive birefringence. [See Abstract 3657 (1929).] G. E. A.

337. Crystallisation in Strong Magnetic Fields. L. A. Welo. *Phys. Rev.* 34. *pp.* 296–299, *July* 15, 1929.

Lead, tin, bismuth, nickel chloride and potassium ferricyanide were crystallised in strong magnetic fields and examined for changes in the magnetic susceptibilities. The changes, if any, were not more than 0·16 % in Pb, 0·29 % in Sn, 0·32 % in Bi, 0·42 % in $NiCl_2$ and 0·04 % in $K_3Fe(CN)6$. AUTHOR.

338. Diamagnetism and Space Charge Distribution of Atoms and Ions. E. C. Stoner. *Leeds Phil. and Lit. Soc., Proc.* 1. *pp.* 484–490, *July*, 1929.

The author uses Hartree's method of a self-consistent field to get the theoretical space charge distribution for spherically symmetrical ions and atoms and from this values of the diamagnetic susceptibility are calculated for He, Li^+, Na^+, K^+, Rb^+ and Cl^-. The experimental results of Joos, Ikenmeyer, and Wills and Hector are discussed, and for He calculated and observed values agree to 1 %, while for positive ions satisfactory agreement is obtained. For the free Cl^- ion the calculated value is much greater than that found for the ion in solution. It is not clear whether this is due mainly to errors arising from the difficulties in calculating the self-consistent field for r, large with a negative ion, or to the special boundary conditions producing important modifications in the distribution. [See Abstract 1986 (1928).] R. S. R.

339. Heaviside's Fractional Differentiation. W. E. Sumpner. *Phys. Soc., Proc.* 41. *pp.* 404–425, *June* 15, 1929.

Defining the operator p^a applied to a power series $\Sigma C_n \frac{t^n}{n!}$ as yielding $p^a \Sigma C_n \frac{t^n}{n!} = \Sigma C_n \frac{t^{n-a}}{(n-a)!}$ (a is any positive number, t the variable, and C_n constants), the justification for its use in certain problems is established. It is not assumed that the operator has any connection with the differentiator of the calculus, and, in fact, even when a is a positive integer, D^a (the calculus differentiator) and p^a are not identical in meaning. In the *Discussion*, **T. J. I'A. Bromwich** pointed out that the use of complex integrals as a means of interpreting Heaviside's operators is claimed to explain the success of Heaviside's work in general and to throw light on points not easily explained otherwise. Detailed examples were given illustrating these remarks. W. S. S.

340. Eddington's Theory of the Electrical Elementary Quantum. W. Anderson. *Ann. d. Physik*, 2. 1. *pp.* 63–64, *June* 7, 1929.

Eddington, in a recent paper, has called attention to the difficulty, under the old theory, of understanding why the charge of an electron and of a proton should have the same numerical value. The author, however, had previously shown, using the old theory, that an electrical elementary particle can only be divided into still smaller particles if its charge is greater than a definite universal minimal charge, designated as e min. The mass of the particle makes no difference whatever. He found that e min was certainly larger than $1 \cdot 14 \times 10^{-11}$ e.s.u., probably larger than $1 \cdot 14 \times 10^{-10}$ and possibly than $1 \cdot 14 \times 10^{-9}$. H. N. A.

APPARATUS AND INSTRUMENTS.

341. Electrostatic Machines with Condensers. H. Chaumat. *Comptes Rendus*, 188. *pp.* 1546–1547, *June* 10, 1929.

A theoretical discussion of the principle of an electrostatic machine with condensers described in a previous paper. [See Abstract 3623 (1929).] J. J. S.

342. New Electroscope. B. F. J. Schonland. *Cambridge Phil. Soc., Proc.* 25. *pp.* 340–343, *July*, 1929.

A new type of ionisation electroscope is described which combines high voltage-sensitivity with small capacity. It consists of a small rectangular mirror of thin silvered mica, which is itself the electroscope "leaf." J. J. S.

343. New Electrolytic Conductivity Bridge. D. C. Gall. *Journ. Sci. Instruments*, 6. *pp.* 231–233, *July*, 1929.

A new arrangement of a conductivity bridge for the determination of the electrical conductivity of solutions is described. The bridge is fitted with a variable mutual inductance, a substitution resistance box, and a mercury change-over switch, whereby the electrolytic cell can be switched in or out of the circuit. F. J. B.

344. Improved Constant-Current Regulator. L. G. Longsworth and D. A. MacInnes. *J.O.S.A. and R.S.I.* 19. *pp.* 50–56, *July*, 1929.

The regulator, already described [see Abstract 2984 (1926)], was limited in action to adjustments of current for variations in only one direction. An additional device adapts the apparatus for general use. G. E. A.

345. Low-Power Audio-Frequency A.C. Supply for Laboratory Use. C. W. Oatley. *Journ. Sci. Instruments*, 6. *pp.* 217–220, *July*, 1929.

A description is given of an apparatus for providing alternating current of constant frequency and good wave-form for use in bridge measurements. Oscillations are maintained by a standard electrically-maintained tuning-fork, and the alternating output can be fed to several points by means of a special distributing transformer. G. E. B.

346. Large Reciprocating Wilson Cloud Expansion Apparatus. G. L. Locher. *J.O.S.A. and R.S.I.* 19. *pp.* 58–64, *July,* 1929.

A Wilson cloud expansion apparatus arranged for stereoscopic photography has been designed which is particularly useful for statistical investigations of the paths of electrons ejected by X-rays in gases. F. J. W.

347. Theory of the Tiberg-Thalén Magnetometer. V. Theimer. *Zeits. f. Instrumentenk.* 49. *pp.* 342–356, *July, and pp.* 386–395, *Aug.,* 1929.

Studies the theory of the magnetometer, with the Dahlblom modification; and works out accurate formulæ for the different ways of using the instruments, from which approximate formulæ are derived which are of greater accuracy than those derived by Tiberg, Thalén and Dahlblom. Explains the use of the magnetometer in locating the position of masses of magnetic ore below the surface. The ore mass is assumed to have an approximately vertical magnetic axis, and it is shown how, by plotting the curves of equal horizontal magnetic intensity on the surface, the point in which this axis cuts the surface can be determined. H. N. A.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

348. Report of Irish Radium Committee for Year 1928. *Roy. Dublin Soc., Proc.* 19. *pp.* 277–293, *July,* 1929.

349. Local Application of Radium in Therapeutics. Part II. Biradiant Needles. J. Joly. *Roy. Dublin Soc., Proc.* 22. *pp.* 273–276, *July,* 1929.

A description of a radium needle made bilaterally asymmetrical, the one half of the needle being made of iridium or platinum, and the other of steel or glass. In this way the radiations proceeding in opposite directions from the needle perpendicular to its long axis may be made very different. A simple mode of construction by forming the needle of platinum sheet 0·4 mm. thick is described, the sheet making one and a half turns round the central rod. The rod is then withdrawn, leaving an approximate cylinder with the one half having a thickness of 0·4 mm. Pt and the other 0·8 mm. Pt. [See also Abstract 1344 (1914).] W. V. M.

350. Instrument for Rapid Visual Identification of Radium Tubes and Needles. G. W. C. Kaye and W. F. Higgins. *Brit. J. of Radiology,* 2. *pp.* 356–358, *July,* 1929.

An instrument designed and constructed at the National Physical Laboratory to facilitate the rapid visual inspection of large numbers of radium tubes and needles, to minimise handling and provide adequate protection for the observer. W. V. M.

351. Differential Action of X-Rays and γ-Rays upon Some Living Tissues. S. Russ and G. M. Scott. *Brit. J. of Radiology,* 2. *pp.* 301–305 ; *Disc.,* 305–306, *June,* 1929.

In previous work Russ has shown an apparent selective action, dependent on wave-length, in depilation of rats and the action upon Jensen's rat sarcoma. In the present paper still harder X-rays (0·10 Å.) and radium γ-rays have been used. To avoid irregularities both the skin and tumour were simultaneously exposed. The result is that six times as much short-wave energy has to be applied to produce an equal skin reaction and about 2–6 times in the case of the effect on the tumour as in previous work with softer rays. As a result the authors consider: (1) reaction in skin and tumour is dependent not only on the energy absorbed, but also on the wave-length, (2) the extent of this differential action depends on the particular tissue. The theoretical aspects of the selective action are discussed. In the *Discussion*, **Hopwood** drew attention to differences between the results of present and past experiments as regards the ratio values for skin and tumour values. B. J. L.

352. Radium and Radon Tubes [Their Minimum Intensities for Practical Use]. S. Russ and G. M. Scott. *Brit. J. Radiology*, 2. *pp*. 390–400, *Aug*., 1929.

Experiments were made on Jensen's rat sarcoma and show that radium or radon tubes when of too small intensity, whilst inhibiting growth, cannot prevent tumour growth. It is also shown that tumour cells left undisturbed after irradiation are less likely to grow than if removed and inoculated into live rats. It is, therefore, inferred that the surrounding irradiated tissues have an influence on growth retardation and disappearance. B. J. L.

353. Unrecognised Danger in Valve Sets. N. S. Finzi. *Brit. J. of Radiology*, 2. *pp*. 359–360, *July*, 1929.

The danger of X-ray excitation by valves used to rectify alternating current in X-ray apparatus, when worked with insufficient filament current, is pointed out. The author illustrates a film fogged by such stray radiation, and mentions two similar cases other than his own. B. J. L.

354. Dielectric Loss in Electrolyte Solutions in High-Frequency Fields. W. T. Richards and A. L. Loomis. *Nat. Acad. Sci., Proc*. 15. *pp*. 587–593, *July*, 1929.

Scherschewski has reported a biological effect of short-wave electrostatic fields. Christie and Loomis have stated that all such effects are solely due to heat generated by the fields, a view confirmed by other later observers. The present paper is a mathematical investigation (not suitable for brief abstraction) dealing with the effects of high-frequency fields in solutions of inorganic salts. The results have been tested and verified over a considerable range of frequencies and conductivities, and should be applicable for the explanation of the physiological effects induced by high-frequency fields. B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

355. Adsorption of Gases and Vapours and the Langmuir Theory. H. Zeise. *Zeits. f. Elektrochem.* 35. *pp.* 426–431, *July*, 1929.

The first part of the paper contains a discussion of certain criticisms of Polanyi and Hückel respecting the validity of the Langmuir Theory for the adsorption of gases at solid adsorbents, and also of the Berényi experiments which were carried out to explain the considerable deviation between Polanyi's Theory and the measurements of different investigators. In the second section it is shown that for the adsorption of vapours the Langmuir Theory is valid within certain limits which are determined, on the one hand, by particularly strong unions (shown by extremely high thermal data), and on the other by the phenomena of two- and three-dimensional condensation, which partly take place initially and partly at higher densities. Certain cognate investigations are also discussed.

H. H. Ho.

356. Basis of Potential Theory of Adsorption. M. Polanyi. *Zeits. f. Elektrochem.* 35. *pp.* 431–432, *July*, 1929.

Since certain writers have criticised adversely the author's potential theory of adsorption, he now discusses the main difficulty which arises from the relationship of the theory to the range of the adsorption forces, under the following headings: (1) The adsorption forces are independent of the temperature; (2) the adsorption force, which acts upon an adsorbed molecule at a definite point, is independent of whether the neighbouring zone is occupied by adsorbed molecules or not; and (3) the adsorption forces do not influence the inner forces which operate between the adsorbed molecules. In consequence the same equation of state holds, and is applicable to the adsorbed layer, as for the adsorbed substance under ordinary conditions. The last section is explained at length. H. H. Ho.

357. Low-Pressure Adsorption on a Washed-Glass Surface. H. S. Frank. *J. Phys. Chem.* 33. *pp.* 970–976, *July*, 1929.

The adsorption of water vapour upon a heavily acid-washed surface of pyrex was measured at pressures ranging from $5 \cdot 2 \times 10^{-3}$ to $8 \cdot 7 \times 10^{-2}$ mm. of mercury. A known amount of water was introduced into a space of known volume at a known temperature and the pressure was measured. The difference between this measured pressure and that calculated from the gas laws represented the water removed from the gas phase by adsorption on the walls. The pressure gauge used was of the membrane or diaphragm type, and was entirely composed of glass. The movement of the glass diaphragm was communicated to a thin aluminium disc forming one plated of a parallel plate condenser, the change in capacity of which was measured. The manometer was calibrated by comparison with a McLeod gauge using air dried in a liquid-air trap. The results show that the adsorption process is slow, a steady state, in general, not being reached in fifteen minutes. There is evidence against the applicability of the Langmuir theory of adsorption; the experiment rather lends support to the conclusion that the surface is covered with a layer of silica gel.

W. C. S. P.

358. Adsorption and Solution Volume. A. Rabinerson. *Kolloid Zeits.* 48. *pp.* 231–237, *July*, 1929.

The adsorption of succinic and acetic acids by birch charcoal was experimentally determined. Hydrochloric acid was employed as a comparison material in some cases. The relationship of *x*, the amount adsorbed to *m*, the quantity of carbon used, was determined for different amounts of the acids. Varying volumes of the acid solutions were shaken with one gramme of the charcoal, and the change of concentration determined by titration. The results showed that when *a* (concentration of the acid) and *m* were kept constant, *x* decreased as *v* increased. F. J. B.

359. Adsorption Hysteresis. A. R. Urquhart. *Shirley Inst., Mem.* 8. *pp.* 19–26, *April*, 1929. *J. Textile Inst.* 20. *T. pp.* 117–124, 1929.

The earlier work of this author, as well as the general theories of Zsigmondy and McGavack and Patrick, is referred to. It is concluded that the presence of non-condensable gases is not sufficient to explain the phenomenon. It is further observed that the adsorption hysteresis for cotton is an intrinsic property of the material, which cannot be explained away as being due to faulty methods of experiment. J. K.

360. Mechanism of Adsorption of Water by Cotton. A. R. Urquhart. *Shirley Inst., Mem.* 8. *pp.* 27–34, *April*, 1929. *J. Textile Inst.* 20. *T. pp.* 125–132, 1929.

In this paper is discussed the intimate structure of cotton regarded as a colloidal gel, and a theory is presented which has been of value in explaining on a common basis many apparently unrelated observations. The theory, though originally developed for cotton, has been found applicable to starch and for explaining some of the phenomena observed generally with elastic gels. J. K.

361. Two-Phase Theory of Adsorption of Water Vapour by Cotton Cellulose. F. T. Peirce. *Shirley Inst., Mem.* 8. *pp.* 35–52, *April*, 1929. *J. Textile Inst.* 20. *T. pp.* 133–150, 1929.

The present paper is an attempt to present a clear mental picture of the way in which water enters into cotton and how it effects it. The effects are divided into two classes: (1) the influence of adsorbed water on the physical properties, strength, elasticity, rigidity, swelling and evolution of heat; (2) the supply of necessary moisture by the adsorbed water for chemical reactions and growth of organisms. It is observed that the mathematical expression for the adsorption isotherm presented does not bear any close resemblance to those discussed in the literature. J. K.

362. Heat of Wetting of Powders with Solutions and Heat of Adsorption. P. Rehbinder and F. L. Krajuschkina. *Zeits. f. phys. Chem.* 142. *Abt. A.* 4. *pp.* 282–288, *July*, 1929.

Determinations of the heats of wetting and the heat of adsorption of powders in solutions of substances having limiting surface activity. Solutions in water and hexane were employed. It was found that for hydrophile powders the heat of wetting increased with the polarity (dielectric constant) of the pure liquid, and for hydrophobe powders a decrease was observed. The latter fact denoted that the heat of flotation was positive. The heat of adsorption is smallest for adsorption from the solvent which exhibited the greatest heat of wetting. The dependence of the differential and integral heat of adsorption was shown to depend upon the concentration. F. J. B.

363. Heat of Adsorption of Oxygen on Charcoal. M. J. Marshall and H. E. Bramston-Cook. *Am. Chem. Soc., J.* 51. *pp.* 2019–2029, *July*, 1929.

The differential heat of adsorption of oxygen on activated cocoanut charcoal was measured as a function of the gas concentration on the charcoal. The maximum heat of adsorption at zero concentration was found to be 89,600 calories per mol of oxygen. The specific nature of the adsorption and the constancy of the charcoal surface was emphasised by the similarity of the heat of adsorption against gas concentration on the surface curve with that obtained in previous investigations. The specific surface of the charcoal was estimated to be between $2 \cdot 8 \times 10^4$ and $6 \cdot 1 \times 10^4$ sq. cm. per gramme. F. J. B.

364. Orientation of Molecules on Solid Boundary Faces and Range of the Orienting Forces. D. Talmud. *Zeits. f. phys. Chem.* 142. *Abt. A.* 3. *pp.* 233–236, *July*, 1929.

When powdered $CaCO_3$ (or $BaSO_4$) is stirred in water, a drop of oleic acid added, and a light organic liquid (benzene, alcohol, petroleum) is poured on the surface, the hydrophile powder retains much of this liquid after stirring; the powder swells like a gel. On adding some mineral acid or an excess of oleic acid the powder balls up, drops rise from it, and after some hours separation of liquid, water and powder is complete. According to J. Traube, powdered galena (hydrophobe) retains some benzene under water, but releases it on addition of oleic acid. These experiments agree with Rehbinder's view on flotation, that substances which, like oleic acid, strongly diminish the absolute wetting by a liquid are predominantly adsorbed by a solid surface of greater polarity difference, the adsorption being from the water at the hydrophobe wall, from organic solvents at the hydrophile wall. Thus, oleic acid is adsorbed by the $CaCO_3$ from the benzene, and by PbS from the water. Quartz does not extract benzene on addition of oleic acid, but does so in the presence of lime; the $CaSiO_3$ then makes the surface hydrophobe. This agrees also with the views of Langmuir (on orientation of molecules in monomolecular layers) and of Fajans (ions forming insoluble compounds are adsorbed by preference). Some experiments are described on the determination of the range of the orienting forces by measuring the thickness of the adsorbed layer on freshly precipitated $CaCO_3$. H. B.

365. Surface Films on Water and Molecular Dimensions. A. Marcelin. *Comptes Rendus*, 189. *pp.* 236–238, *July* 29, 1929.

The coefficient of re-expansion (on increase of temperature) of a film decreases as the benzene solution of the substance used is more dilute, but rarely falls below 1·5 and never to 1·0. "Corrected" thereby, Langmuir's results for a monomolecular film [*Am. Chem. Soc., J.* 39, p. 1868, 1917] are much lower than those obtained by X-ray examination. In view of Émir's results [see Abstract 3668 (1929)] it is concluded that the molecules are really close-packed on the surface, not at "maximum expansion," but at "saturation." A film the thickness of which is accurately equal to the length of a molecule (l) can therefore be obtained by first expanding to "maximum extension" by raising the temperature, and then compressing the "superficial solution" thus obtained to "saturation." Hence is deduced the formula $l = VC/SE$, where V is the volume of the substance occupying at maximum expansion the area S; E the coefficient of expansion to the state of "superficial solution"; and C the coefficient of reduction of area necessary to compress to "saturation." C usually lies between 1·5 and 2, and E/C differs little from unity. Results thus deduced agree well with X-ray results for oleic, myristic, palmitic and stearic acids. [See also Abstract 2374 (1925).] C. A. S.

366. Surface Solutions and Molecular Films. Study of Certain Bodies and Determination of Length of their Molecules. F. Émir. *Comptes Rendus*, 189. *pp.* 239–240, *July* 29, 1929.

Marcelin's formula for l (see preceding Abstract] is applied to the determination of the length of the molecules of palmitic acid (E = 1·76, C = 2·46, l = 17·8 Å), stearic acid (E = 1·47, C = 1·94, l = 19·4 Å), and cetyl alcohol (l = 23·5 Å), results agreeing well with X-ray determinations, 17·8, 19·8 and 23·0 Å respectively. C. A. S.

367. Surface Solutions of Oleic Acid; Measurement of Very Low Pressures. J. Guastalla. *Comptes Rendus*, 189. *pp.* 241–243, *July* 29, 1929.

Marcelin has shown that if S is the area of a " saturated surface solution " of oleic acid (assumed to be monomolecular with molecules close-packed), P the surface pressure and T the temperature, PS = KT for expansions up to 28S, K being approximately = R/20. By means of an improved form of Marcelin's apparatus the expansion of a film of oleic acid on *N*/100 hydrochloric acid at 19° has been investigated up to 1000S (30,000 Å^2). The expansion curve falls rapidly to 2S, then more slowly to 17S, agreeing well with that required by Marriotte's law with K = R/20; from 17S to 170S it is almost horizontal, but thereafter approaches a Marriotte hyperbola with K = R. [See also the two preceding Abstracts.] C. A. S.

368. Removal of Dissolved Gases from Liquids by Vacuum Sublimation. J. H. Hibben. *Bureau of Standards, J. of Research*, 3. *pp.* 97–104, *July*, 1929.

A method of removing and collecting dissolved gases from liquids is described. It is possible, through the application of the principle of vacuum sublimation, to prepare gas-free liquids for use in the determination of physical constants without appreciable loss of either liquid or dissolved gas. Experimental results are presented which demonstrate the practicability of the method as well as its theoretical limitations. AUTHOR.

369. Heats of Solidification and of Solution of Saccharose. A. Tian. *Comptes Rendus*, 189. *pp.* 164–167, *July* 22, 1929.

Super-fused sugar has a positive solution-heat, while that of crystallised sugar is negative. Measurements are described and given. A. D.

370. Solubilities of Soluble Electrolytes. Part I. Relationship between Temperature Coefficients. A. F. Scott. *J. Phys. Chem.* 33. *pp.* 1000–1014, *July*, 1929.

A preliminary study of the solubility of soluble electrolytes was carried out. Relationships between the temperature coefficients of solubility were indicated, and an attempt to develop an outline of a theory which would explain these relationships was made. The examination of the solubility curves led to the discovery of a number of discontinuities which had not been recognised previously. The significance of these discontinuities is discussed in the light of the present theory. F. J. B.

371. Limiting Solution-Heats. J. Perreu. *Comptes Rendus*, 189. *pp*. 167–169, *July* 22, 1929.

Discussion of the methods in use for determining the solution-heats of hydrated salts. Measurements for carbonate of soda, dibasic phosphate of sodium, chloride of barium, sulphate of sodium, sulphate of copper.

A. D.

372. Plastometric Studies on Formation of Limiting Boundaries. A. de Waele and G. L. Lewis. *Kolloid Zeits.* 48. *pp*. 126–141, *June*, 1929.

A critical study of the behaviour of mixtures of powders of various materials with mineral and other oils. It is shown that a pseudo-solid layer surrounds the dispersed particles of a colloid or plastic system. A method is developed whereby the ratio of the volume of this pseudo-solid phase to the accompanying phase can be determined. The ratio of the thickness of the pseudo-solid phase to the radius of the disperse particles depends upon the size of the particle, is inversely proportional to the degree of dispersion, and in a given solid-liquid system it was constant over a range of concentration. This ratio is shown to be of great importance in the characterisation of a system, and is closely allied with the flow-solidity and the general colloidal properties. Experiments throwing light upon the nature of this layer, its physical properties, and its effect are described. Abnormalities of plastic flow are described, which are the consequence of adsorption of the solid peptisator on the surface of the disperse particles, and the phenomenon is discussed. F. J. B.

373. Validity of Stokes' Law for Non-Spherical Particles. A. H. M. Andreasen. *Kolloid Zeits.* 48. *pp*. 175–179, *June*, 1929.

A review of previous publications in this field is first given, following which comes a description of experiments which establish the validity of the Stokes' law for flint particles. Curves and micro-photographs are included in the paper. H. H. Ho.

374. Intensity of Tyndall Light in Agar Gels. E. Hatschek. *Kolloid Zeits.* 48. *pp*. 246–248, *July*, 1929.

Investigations of the intensity of Tyndall light in agar gels were made by Hatschek and Humphreys [see Abstract 221 (1925)], and by Krishnamurti [see Abstract 1514 (1929)], who showed that the intensity of the scattered light was greater in the gels than in the sols. It was concluded that in the condition of the gel the number or the magnitude, or both, were greater than in the sol. The results of the latter author are reconsidered and his conclusions discussed in the present paper. F. J. B.

375. Coagulation in Smokes, H. S. Patterson, R. Whytlaw-Gray and W. Cawood. *Roy. Soc., Proc.* 124. *pp*. 502–522, *July* 1, 1929.

The authors carry out further experiments on smokes and study the possible influence of the degree of heterogeneity and of electrification, as well as the effect of size on the rate of coagulation. Before embarking on this programme, the process of counting was scrutinised, errors eliminated and the method improved. E. E. F. d'A.

376. Structure and Electrification of Smoke Particles. H. S. Patterson, R. Whytlaw-Gray and W. Cawood. *Roy. Soc., Proc.* 124. *pp*. 523–532, *July* 1, 1929.

The experiments have brought to light no marked difference in the coagulation rates of comparable smokes which differ greatly in electrical character. The difference between the rate of coagulation of comparable smokes of MgO and ammonium chloride indicate that electrification exercises little, if any, effect. Moreover, the authors have as yet detected no appreciable difference in the coagulation of ammonium chloride smokes of the same weight concentration, dispersed either normally or in the presence of X-rays. E. E. F. d'A.

377. Electrolytically Deposited Metals. F. Foerster and K. Klemm. *Zeits. f. Elektrochem.* 35. *pp.* 409–426, *July*, 1929.

Earlier work of F. Foerster and J. Fischer on the deposition of tin from solutions of stannous sulphate in the presence of sulphonated products of *m*-cresol and crude cresol sulphonic acid is continued. It was found that the adsorption of substances contained in the crude cresol sulphonic acid and the resinous condensation products, at the kathode, prevented the tendency of the tin to grow into needles. Cadmium is deposited in needle form from acid solutions of cadmium sulphate, and to a greater extent from ammoniacal sulphate solutions. Cresol sulphonic acid, which was purified from resinous matter by filtration through animal charcoal, tended to prevent the formation of needle crystals in the case of cadmium, but the addition of crude cresol sulphonic acid which prevented the formation of needle crystals of tin caused a spongy deposit of cadmium. The use of a kathode of large crystals of cadmium influenced the structure of the cadmium deposited upon it. Zinc and lead were found to be influenced in the same way by crystal structure of the kathode. F. J. B.

378. Fibrous Structure in Metals Deposited by the Difference in Electrolytic Solution Pressures. S. Tsuboi. *Kyoto Coll. Sci., Mem.* 12. *pp.* 209–215, *July*, 1929. *In English.*

The arrangement of micro-crystals in the thin plates of metallic lead and cadmium, which were deposited from some salt solutions by a piece of zinc being put into the solutions, was examined. The majority of the micro-crystals in the lead deposits have one of the (111) planes of the cubic crystal nearly parallel to the flat surfaces of the deposits. In the case of cadmium deposits, the (0001) plane of the hexagonal crystal is situated nearly parallel to the flat surfaces of the specimens. [See Abstract 2903 (1928).] AUTHOR.

379. Favourable Direction of Growth of Some Metal Crystals. S. Tsuboi. *Kyoto Coll. Sci., Mem.* 12. *pp.* 223–226, *July*, 1929. *In English.*

The favourable crystallographic direction of growth of various metal crystals is examined in the present experiment. Most of the aluminium and lead crystals grow in the direction nearly parallel to the [100] axis of the face-centred cubic crystals of these metals. The majority of the zinc, cadmium and bismuth crystals grow in the direction nearly perpendicular to the principal axis of the hexagonal crystals of these metals. AUTHOR.

380. X-Ray Investigation of Iron and Zinc Alloys. A. Ôsawa and Y. Ogawa. *Tohoku Univ., Sci. Reports,* 18. *pp.* 165–176, *June,* 1929. *In English. Report No.* 220 *from the Research Inst. for Iron, Steel and other Metals.*

The X-ray analysis was carried out for the alloys of iron and zinc.

The result of this analysis confirmed the correctness of the new diagram of the Fe-Zn system recently published by one of the writers, and also the existence of two compounds Fe_3Zn_{10} and $FeZn_7$. The crystal form of the compound Fe_3Zn_{10} is cubic, having 9 Å. as the lattice constant and containing 52 atoms in a unit cube, its space group belongs to one of T^d, O and O^h, probably to the latter. The crystal form of $FeZn_7$ belongs to the hexagonal system, having an axial ratio of 1·60 and the hexagonal close-packed lattice as the atomic distributions. AUTHORS.

381. Influence of Transformation Point in Iron and Steel on Moulding. F. Sauerwald and T. Sperling. *Zeits. f. Physik*, 56. 7–8. *pp.* 544–547, 1929.

Tests were made on samples of a perlite steel and a Krupp soft iron, and the cooling and heating curves found during the working of fractured samples. It was found that Ac_1 has its temperature lowered 7°, Ac_3 by 4°, and Ar_3 raised by 4°, and the last gives the largest value for 1° change. The decrease of hysteresis by working was evidently limited in the first case by the influence of the rate of transformation on the working. On the other hand, the question arises whether with the observed effect an influence of the thermodynamic functions by working can be perceived. [See Abstract 1925 (1927).] R. S. R.

382. Comparison Between the Behaviour at the AC_3 Point of Single and Polycrystal Iron, both in the Strained and Unstrained State. H. Quinney. *Roy. Soc., Proc.* 124. *pp.* 591–603, *July* 1, 1929.

A study has been made of the effect of initial crystal size on the behaviour of pure iron, during its passage through the Ac_3 point, when the crystal structure changes from the body-centred to the face-centred cubic lattice. It is found that there is no change in the temperature of the Ac_3 point whether the iron passes at the transition temperature from the single to the polycrystalline condition or is throughout polycrystalline. There is, however, a very marked change in the form of the temperature-time curve at the Ac_3 point, which shows that the heat absorption is less for the polycrystalline than for the single crystal variety. It is suggested that this difference is to be accounted for by the existence of surface energy at the crystal faces of the polycrystalline iron. In support of this hypothesis it is shown that the heat absorption at the Ac_3 point is lessened considerably by mechanical overstrain. An estimate has also been made of the relative contraction of single crystal and polycrystal iron at the Ac_3 point. F. J. W.

383. Ternary Alloys of Copper-Aluminium with Manganese, Tin or Cobalt. E. Morlet. *Comptes Rendus*, 189. *pp.* 102–104, *July* 8, 1929.

Most of the alloys contain about 10 % of Al. Manganese, 1 to 6 %, is dissolved by the α and γ constituents and does not cause the formation of a special compound. With increasing Mn percentage both the Brinell hardness and the electric resistance rise. When the alloys are heated between 470° and 550°, there is eutectic transformation at two points which merge into one transformation of larger amplitude as the Mn content is raised. Slow cooling does not affect this change; cooling in air lowers it to 330°; quenching in water gives rise to a martensite. In the case of tin, a special δ constituent, brilliant white, appears, when both the Al and Sn percentages are below 6, which on quenching in water enters into solid solution;

the alloys are brittle. There is also a special compound in the cobalt alloys. H. B.

384. Composition of ϵ Bronze. W. Hume-Rothery. *Phil. Mag.* 8. *pp.* 114–121, *July*, 1929.

The composition of bronze was investigated. The alloys were made from pure electrolytic copper and "Chempur" tin. Annealing was carried out to determine the limits of solid solution. The results showed that ϵ bronze was a solid solution in which the percentage of tin may vary from 24·5 to 25·1 atomic %. X-ray data point to the existence of a compound of copper and tin $Cu_{50}Sn_{16}$, or to the simpler compound CuSn. Lack of agreement between X-ray and metallographic results was ascribed to determinations made on alloys which had been insufficiently annealed to reach the final state of equilibrium. F. J. B.

385. Optical Investigation of Active and Passive Metallic Mirrors. L. Tronstad. *Zeits. f. phys. Chem.* 142. *Abt. A.* 4. *pp.* 241–281, *July*, 1929.

Iron and nickel mirrors were prepared by careful polishing of the surface until as high a burnish as possible was obtained. The polarisation of the reflected light was measured by a polarisation spectrometer. The surface was rendered active and passive by electrolysis in a suitable solution, and the polarisation again measured in the active and passive state. The results indicated that the passivity of the metal was due to an oxide film. When iron and nickel were rendered passive in an alkaline solution, the optical properties tended to reach a characteristic limiting value. The optical properties changed in the opposite direction when rendered active from those which were characteristic of the passive state. The passive state was considered as due to an oxide layer or film which was perfectly continuous, and the active state was associated with a perforated or porous oxide film. F. J. B.

386. Passive State of Metals. I. N. Stranski and Z. C. Mutaftschiew. *Zeits. f. Elektrochem.* 35. *pp.* 393–395, *July*, 1929.

A new possible explanation of the passivity of metals is developed. The theory is based upon some new data on crystal growth and solution, in which it is shown that the solution of a crystal is retarded when the removal of the units of structure from the surface of the crystal is small compared with the total number of these units. Such units of structure occupy the corners and edges of the crystals. F. J. B.

387. Theory of Passivity. R. Müller. *Zeits. f. Elektrochem.* 35. *pp.* 459–460, *July*, 1929.

The paper forms a contribution to the discussions on the theory of passivity. The influence of the hydrogen and oxygen layers on the metals as a cause of the passivity is discussed. F. J. B.

388. Distribution and Velocity of Corrosion of Metals. U. R. Evans. *Frank. Inst., J.* 208. *pp.* 45–58, *July*, 1929.

The main conclusions previously arrived at [see Abstracts 2428 (1927), 2039 and 2040 (1929)] are summarised, and it is shown how the principles developed may be extended to the consideration of the velocity of corrosion. T. H. P.

389. Photochemical Action on Cholesterol and Ergosterol. E. Rousseau. *Comptes Rendus,* 189. *pp.* 37–39, *July* 1, 1929.

Investigations were made by a method in which the iodine of an iodide was displaced by an oily solution of cholesterol or ergosterol irradiated by solar light. It was found that ergosterol shows a power of oxidation superior to that of cholesterol when these in oily solution, with limited presence of air, are submitted to the action of complete solar radiations. The photochemical effect produced by solar radiations was ten times greater than that produced by the three radiations from an arc in vapour of mercury, 3650 Å., 3341 Å., 3132 Å., or the monochromatic radiation 3650 Å. alone from that arc. J. J. S.

390. Oxidation of Zymosterol by Sunlight. E. Rousseau. *Comptes Rendus,* 189. *pp.* 173–174, *July* 22, 1929.

Following up a paper on the oxidising effect of sunlight on oil-solutions of ergosterol and cholesterol, the author has extended his investigations to zymosterol. A. D.

391. Mechanism of Photochemical Changes in a Fluorescent Solution. J. C. Ghosh. *Zeits. f. phys. Chem.* 3. *Abt. B.* 6. *pp.* 419–426, *June,* 1929.

Measurements were made of the e.m.f. of photochemical cells which contained a fluorescing electrolyte. The solutions employed were uranium salts in water, fluorescein in sodium hydrate, and rhodamin B in alcohol. The dependence of the e.m.f. on time and intensity of illumination was investigated, and the results are utilised to explain the mechanism of the reactions which take place in these cells. F. J. B.

392. Photochemical Formation of Phosgene. M. Bodenstein, S. Lenher and C. Wagner. *Zeits. f. phys. Chem.* 3. *Abt. B.* 6. *pp.* 459–478, *June,* 1929.

It was found that the formation of phosgene at room-temperature by photochemical action proceeded more slowly at low pressures than was to be expected from the equation representing the velocity of the reaction at ordinary pressures. Reaction velocity measurements were made by exposing mixtures of carbon monoxide and chlorine to the light of a gas-filled lamp. The reaction mixture was contained in quartz vessels, and the progress of the reaction was followed by the changes of pressure. The results indicate that diffusion of the atoms of chlorine to the walls of the containing vessel takes place and that the atoms recombine. Some doubtful points of the reaction in general are cleared up, and the scheme of the reaction is outlined from the laws of the reaction which are found to be obeyed, in light and in the dark, and at temperatures from room-temperature and at 200° to 300° C., and when illuminated at temperatures above 400° C. F. J. B.

393. Photochemical Equilibrium in Nitrogen Peroxide. Part II. Dependence of Quantum Efficiency on Wave-Length. R. G. W. Norrish. *Chem. Soc., J. pp.* 1158–1169, *June,* 1929.

The quantum efficiency (γ) of the photochemical reaction

$$2NO_2 \underset{\text{Dark}}{\overset{\text{Light}}{\rightleftarrows}} 2NO + O_2$$

has been investigated for six wave-lengths of the mercury-vapour lamp in the visible and ultra-violet, a photoelectric cell being used to measure light intensity. The following values were obtained:—

$\lambda(\mu\mu)$	575, 546, 436	405	365	316–265
γ	0·000	0·74	2·10	2·07

The photochemical threshold in the middle of the nitrogen peroxide absorption region noticed by Dickinson and Baxter (*Am. Chem. Soc., J.* 50. 774, 1928) has been found to be sharper than was originally supposed, their observation of slight photochemical activity of light of $\lambda 436$ $\mu\mu$ being definitely unconfirmed. The existence of fine structure in the NO_2 absorption spectrum is in agreement with the mechanism $NO_2 + h\nu = NO_2'$; $NO_2 + NO_2' = 2NO + O_2$, which is also confirmed by the kinetic observations in Part I. [See Abstract 2637 (1927).] H. H. Ho.

394. Photochemical Equilibrium in Nitrogen Peroxide. Parts III and IV. R. G. W. Norrish. *Chem. Soc., J. pp.* 1604–1621, *July,* 1929.

It is indicated that far more energy is required to decompose the molecule photochemically than thermally. On the basis of these considerations a general distinction based on Franck's views [see Abstract 1940 (1926)] is drawn between spectral excitation and photochemical activation, a principle of limited availability of absorbed light energy being involved. This hypothesis leads to certain conclusions and predictions connecting fluorescence with photochemical activity in nitrogen peroxide. The predicted fluorescence was detected and photographed. The energy relationships confirm the theoretical conclusions, and a general scheme connecting fluorescence with photochemical activity in nitrogen peroxide is suggested. The bearing of this result on thermal heat of activation is further discussed. H. H. Ho.

395. Photochemical Decomposition of Hydrazine. J. C. Elgin and H. S. Taylor. *Am. Chem. Soc., J.* 51. *pp.* 2059–2082, *July,* 1929.

Gaseous hydrazine is decomposed photochemically by the ultra-violet radiation from a quartz mercury arc. A more rapid decomposition is brought about by optically excited mercury atoms. The products of the reaction in both cases are ammonia, nitrogen and hydrogen in amounts indicating a reaction according to the stoichiometric equation $2N_2H_4 \rightarrow 2NH_3 + N_2 + H_2$. Decomposition of the ammonia formed follows this reaction. The products from the thermal decomposition in a quartz bulb indicate reaction mainly according to the equation $3N_2H_4 \rightarrow 4NH_3 + N_2$. The rate of the purely photochemical decomposition is uninfluenced by temperature or by the presence of large concentrations of ammonia or hydrogen, whilst that of ammonia proceeds at a rate one-tenth that of hydrazine under the same conditions. The sensitised hydrazine decomposition is very rapid and is a chain reaction with a minimum quantum efficiency of 13 molecules per absorbed quantum. The rate of the sensitised reaction is unaffected by the presence of nitrogen, ammonia, or hydrogen in large concentrations, and is directly proportional to the incident light intensity. It appears that hydrazine presents a case of "predissociation." The results obtained are satisfactorily explained by a reaction mechanism based upon a dissociation of the primarily excited molecule as a primary process, and not one involving an activated molecule. Agreement is obtained if the dissociation is either into N_2H_3 and H or $2NH_2$. Thermal calculations for the various primary and secondary processes discussed are given. The nature of the absorption spectrum is in accord with such a mechanism if the idea of Bonhoeffer and Farkas be accepted. [See Abstract 2716 (1928).] H. H. Ho.

396. Photolysis of Potassium Ferrioxalate Solutions. A. J. Allmand and W. W. Webb. *Chem. Soc., J. pp.* 1518–1537, *July*, 1929.

The decomposition of potassium ferrioxalate by exposure to the light of a quartz-mercury lamp is investigated, the separation of the insoluble ferrous oxalate being prevented by a sufficient concentration of potassium oxalate. The results are critically discussed, and a general theory of the reaction is put forward to explain the results. F. J. B.

397. Rate of Recombination of Atomic Hydrogen. H. M. Smallwood. *Am. Chem. Soc., J.* 51. *pp.* 1985–1999, *July*, 1929.

It has been found [see Abstract 1323 (1925)] that certain exothermic reactions of the type $A + B \rightarrow AB$ cannot result from simple binary collisions of molecules A and B, since, in such a collision, there is no means by which the energy corresponding to the heat of the reaction may be removed from the colliding molecules. In order to react, the molecules must collide in the immediate neighbourhood of some other object such as another molecule or the wall of the containing vessel—*i.e.*, reaction can only take place as the result of triplet impacts or three-body collisions. Only a few reactions, however, proceed according to this mechanism, among which is the recombination of atomic hydrogen, and the present paper describes a measurement of the rate of this reaction through the pressure range 0·5–0·9 mm. of mercury. The method used was to allow dissociated hydrogen drawn from an electric discharge to pass along a straight tube, the degree of dissociation at varying distances along the tube being determined by measuring the heat effect produced upon a piece of platinum foil placed in the flowing gas at the desired distance from the discharge, Wood having shown that metals cause the complete recombination of the atomic hydrogen. It was found that, under the conditions of the experiment, one-fifth to one-sixth of the atomic hydrogen present reacted with solid sulphur, and that nitric oxide catalyses the recombination of the atomic hydrogen. The data obtained are in accordance with the predicted three-body mechanism. H. H. Ho.

398. Bunsen Flames of Unusual Structure. F. A. Smith and S. F. Pickering. *Bureau of Standards, J. of Research,* 3. *pp.* 65–74, *July*, 1929.

A mixture of air or oxygen with a combustible gas is forced through a cylindrical burner tube, and the flame is observed as it burns in secondary air. Complex structures observed in acetylene-air flames include the intersection of two zones, four distinct zones of light, and a hollow dark core extending upward from the tip of the primary zone. When secondary air is excluded, the primary zones of some hydrocarbon-air flames become polyhedral. Flames having 3, 4, 5, 6 and 7 sides have been observed, which will rotate under some conditions and remain stationary under others. The number of sides is a function of the size of the burner tube and of the composition of the gas mixture. Burning in secondary air under some conditions, the primary zone of a propane-oxygen flame becomes polyhedral, and yellow streamers rise from the tip and corners of the figure, which can be made to rotate slowly, or rapidly, or to remain stationary, by slight changes of the composition and velocity of the mixture of gas and oxygen supplied to the burner. Accurate and reproducible control of the consumption and rate of flow of the gas mixtures and very steady streamline flow in the burner tubes have been attained. Twenty photographs of the above flames are presented and discussed. AUTHORS.

399. Types of Unimolecular Reactions. O. K. Rice. *Nat. Acad. Sci., Proc.* 15. *pp.* 459–462, *June*, 1929.

Considers predissociation, unimolecular decompositions of complex organic compounds, and photochemical decomposition of the same compounds, all in the gaseous state. Problems relating to predissociation have already been dealt with on the basis of the new mechanics. Unimolecular decompositions have been treated using classical and old quantum theory statistical methods; the energy seems to be obtained by collisions, and not by absorption of light, and is presumably not electronic energy but the energy of vibrations of the atoms within the molecule. It appears that decomposition only occurs when the requisite energy becomes localised in a certain oscillator of the molecule. There is a close analogy with the case of predissociation, only that the transition is from one vibrational state to another rather than from one electronic state to another. In photochemical decomposition of a complex molecule matters are more complicated, with first an electronic excitation and then transitions, in which exchanges of energy take place between the oscillators. H. N. A.

400. Unimolecular Reactions. L. S. Kassel. *Nat. Acad. Sci., Proc.* 15. *pp.* 601–603, *July*, 1929.

The method by which Bourgin [see Abstract 2866 (1929)] attempts to apply quantum mechanics to unimolecular reaction rates is criticised. The author considers that the process of dissociation is probably a radiationless quantum jump from a level in the discrete spectrum of the molecule to a level in the continuous spectrum; the two spectra overlap, and the two levels involved have the same energy. A. J. M.

401. Kinetics of Combination of Nitric Oxide and Oxygen at Low Pressures and under a Strong Magnetic Field. G. Kornfeld and E. Klingler. *Zeits. f. phys. Chem.* 4. *Abt. B.* 1–2. *pp.* 37–66, *June*, 1929.

A special membrane manometer has been devised, and is comprehensively described, for investigating the reaction $2NO + O_2 = 2NO_2$ at minute pressures down to and below 1 mm. At such pressures the reaction appears to be trimolecular, as found by Bodenstein for higher pressures, and the constants now found are in agreement with the data of Bodenstein. A magnetic field appeared to be without influence on the reaction velocity. H. H. Ho.

402. Energy of Hydration of Hydroxyl Ion. F. J. Garrick. *Phil. Mag.* 8. *pp.* 102–107, *July*, 1929.

The energy of hydration of hydroxyl ion was obtained by two methods. The first was based on a cycle and certain assumptions, and was independent of other ionic heats of hydration, lattice energies, and absolute potentials. The second method derived the required value from the lattice energy of the alkali hydroxides. The two methods yielded results which were in good agreement. The value obtained for the work of hydration of the OH ion was 92 kg. cal./mol. F. J. B.

403. Work of Dissociation of Oxygen. G. Herzberg. *Zeits. f. phys. Chem.* 4. *Abt. B.* 3. *pp.* 223–225, *July,* 1929.

Reasons are given for concluding that the value hitherto accepted for the work of dissociation of oxygen is 1 to 2 volts too great, the corrected value for the normal state being 6·5 volts and for the $^1\Sigma$-state 6·1 volts. This involves changes in the values for compounds of oxygen, the work of dissociation for CO being thus about 10 volts and that of NO 6·5 volts instead of 11 and 7 volts respectively, which are given by linear extrapolation. [See Abstract 1053 (1929).] A. W.

404. Heats of Dissociation of the Molecules, CH, NH, OH and HF. D. S. Villars. *Am. Chem. Soc., J.* 51. *pp.* 2374–2377, *Aug.,* 1929.

In an investigation on the dissociation energetics of the molecule of hydrogen cyanide, it was necessary to make an estimate of the heats of dissociation of its different possible decomposition products. Although it may seem strange to speak of the molecules, CH, NH and OH, nevertheless their existence is claimed to be definitely proved by the observation of their band spectra. These data have now been interpolated by Mecke's method [see Abstract 2895 (1927)], and the magnitudes of the heats of dissociation of the molecules CH, NH, OH and HF are calculated to be 82·0, 108·3, 138·0, and 172 kilocalories respectively. H. H. Ho.

405. Activation of Oxygen by Electron Impact. R. H. Dalton. *Am. Chem. Soc., J.* 51. *pp.* 2366–2374, *Aug.,* 1929.

In this paper the chemical behaviour of oxygen activated by electron impact is investigated and the energy necessary for its activation measured. An apparatus similar to that of Glockler, Baxter and Dalton [see Abstract 1572 (1927)] has been employed. The critical potentials of oxygen gas have been determined at various pressures. In addition to the value of 7·9 volts which has been found by previous experimenters, a second critical value was found at 10·6 volts, which appears distinctly only at pressures above 0·1 mm., but becomes very pronounced at pressures of 0·2 to 0·4 mm. In a study of the reactivity towards carbon of oxygen gas excited by electron impact, no reaction occurred below 7·9 volts, but between 7·9 and 10·6 volts a reaction commenced and increased in rapidity up to the highest potentials investigated, the reaction product being mainly carbon dioxide. H. H. Ho.

406. Quantum Mechanics of Chemical Reaction. R. M. Langer. *Phys. Rev.* 34. *pp.* 92–108, *July* 1, 1929.

It is shown that the quantum mechanics is capable of describing processes which have all the aspects of certain chemical reactions. It turns out that a system may change from one configuration to another when a quantum level of the one configuration has the same energy as a quantum level of the other. Among such reactions mention is made and some discussion given of the large classes of molecular rearrangements, and decompositions, including radioactive disintegration. The dependence on pressure and temperature is slightly discussed, and it is indicated that the present theory quite explains the necessity of the old " activation hypothesis " of Arrhenius. The old notions should, however, be modified to take into account that it is not sufficient to have at least the "activation energy" but the molecule must be in a particular state to react. Moreover, when there are several "activated" states the rate of reaction from different ones may be very different indeed. Insight is gained into the nature of certain types of catalytic action, including special wall catalyses. Some features of photochemical reactions are made clear by the theory. AUTHOR.

407. General Formulation of the Phase Rule. P. Kubelka.

Zeits. f. Elektrochem. 35. *pp.* 335–337, *June*, 1929.

A general method for the formulating of the phase rule, based upon spatial arrangements of the phases, is developed. The new method of development is shown to be applicable to the treatment of electrochemical equilibria which exist in galvanic cells. F. J. B.

408. Antimony Electrodes for the Determination of the Hydrogen-Ion Concentration. J. J. Shukoff and G. P. Awsejewitsch.

Zeits. f. Elektrochem. 35. *pp.* 349–352, *June*, 1929.

Various forms of antimony electrodes have been used for *p*H determinations, but they do not give concordant results. The authors' rods of fused antimony, drawn up into glass tubes, were not constant either. But amalgamated platinum wires, coated with Sb by electrolysis of a 25 % solution of $SbCl_3$ in dry acetone, gave constant reproducible values. Their formula for the relation between the e.m.f., E, of this electrode against a normal calomel electrode and *p*H is $E = 0{\cdot}009 + 0{\cdot}053\,p\mathrm{H}$. H. B.

409. Lead Dioxide-Lead Sulphate Electrode. W. C. Vosburgh and D. N. Craig.

Am. Chem. Soc., J. 51. *pp.* 2009–2019, *July*, 1929.

The conditions for the preparation of reproducible lead dioxide-lead-sulphate electrodes were determined. Cells of the type Hg/Hg_2SO_4, $PbSO_4$, $H_2SO_4(xM)/H_2SO_4(xM)PbO_2$, $PbSO_4/Pt$ were constructed, and their electromotive forces were measured over a period of seven to sixteen weeks at 25° C., and at 20°, 30°, 35°, and 40° C. The results enabled the potential of the lead dioxide-lead sulphate electrode to be calculated. The activity coefficient of various concentrations of sulphuric acid, the e.m.f. of the lead storage cell, and the free energy change, the entropy change, and the heat of reaction for the reaction $PbO_2 + 2Hg + 2H_2SO = PbSO_4 + Hg_2SO_4 + 2H_2O$ were also calculated from the results. F. J. B.

410. Potential of Inert Electrode in Solution of Acetic Aldehyde. L. Rapkine.

Comptes Rendus, 189. *pp.* 171–173, *July* 22, 1929.

Observational curve given. The potential is irreversible. A. D.

411. Bimetallic Electrodes for Potentiometric Titration of Hydrogen-Ion Concentration. R. M. Fuoss.

Indust. and Engin. Chem. 1. *pp.* 125–128, *July* 15, 1929.

A number of electrode pairs were employed for the potentiometric titration of changes of hydrogen-ion concentrations. The pairs of metals used were: antimony-lead, antimony-amalgamated copper, bismuth-silver, and copper-copper oxide. All these pairs give satisfactory results, if proper precautions are taken. The author preferred the antimony-amalgamated copper electrode for ordinary acidimetric and alkalimetric determinations. The possible application of such bimetallic electrodes to indicating and recording instruments on process control equipment was indicated. F. J. B.

412. Ballistic Effect Exerted by Polished Metal Plates. J. Loiseleur. *Comptes Rendus*, 189. *pp.* 245–246, *July* 29, 1929.

A freshly polished insulated plate of metal is placed between two identical platinised platinum electrodes situated a few cm. apart in a conducting solution and connected to a galvanometer. When the plate is moved about in any manner between the electrodes a potential difference is observed depending on the nature of the metal and the movement, and increasing as the plate nears an electrode. It is suggested that this is due to the disruption of the layer of liquid attached to the plate. [See S. Procopiu, *J. Chim. Phys.* 19. 21. 1929.] C. A. S.

413. Batteries with Melted Electrolyte. G. I. Costeanu. *Comptes Rendus*, 189. *pp.* 35–37, *July* 1, 1929.

An account is given of the investigation of the action of a battery consisting of oxide of copper–melted caustic soda–zinc. The fundamental reaction is the oxidation of the zinc by the melted soda with liberation of hydrogen. The H reduces the CuO of the anode with the depolarisation reaction: $CuO + 2H = Cu + H_2O$. The battery was examined at the temperature of 400° C. at which the water contained in the soda (about 2 %) is in great part driven off after 4 hours' heating. The behaviour of the battery was tested in air and in an atmosphere of nitrogen. The mean value of the e.m.f. in air was 1·322 volts, and in nitrogen 1·200 volts. The battery could be recommended for the high value of its e.m.f. and its constancy, if the zinc were not strongly attacked even on open circuit. J. J. S.

414. Ammonia(Gas)-Oxygen Cell. C. Marie and C. Haenny. *Comptes Rendus*, 189. *pp.* 149–150, *July* 22, 1929.

The e.m.f. of the cell air|Pt|pyrex glass|Pt|NH_3 falls from 1·090 volts at 570° to 0·951 volt at 790°, corresponding, therefore, to the reaction $4NH_3 + 3O_2 = 2N_2 + 6H_2O$ for which the e.m.f. is 1·1 volts. Below 480° no current passes. C. A. S.

415. Form of the Electrocapillary Curves of Soap Solutions. D. Talmud. *Kolloid Zeits.* 48. 2. *pp.* 164–165, *June*, 1929.

A negative charge [see Abstract 500 (1927)] on the boundary layer air/solution of dilute solutions of sodium benzoate becomes positive in more concentrated solutions. The negative effect is due to the adsorption of organic anions, whilst the positive effect is a consequence of the orientation of the anion or of the molecule. Positive charges have been observed in solutions of benzoic acid, and similar phenomena occur in solutions of sodium butyrate and acetate. The present paper confirms the previous explanation (*loc. cit.*) by measurements of the boundary potentials using Gouy's capillary electrometer. The effect is most pronounced in the case of potassium oleate. The electrocapillary curves are drawn, showing the changes of boundary potential for *N*/10KCl in water with change of polarisation from 0 to 2 volts against a normal calomel electrode, for M/3200, M/1600, M/800, M/400, M/200, and M/100 potassium oleate solutions in *N*/10KCl under the same conditions, and for M/5 potassium oleate alone in water. H. H. Ho.

416. Cataphoresis of Lead Sulphate. E. L. Jewett. *J. Phys. Chem.* 33. *pp.* 1024–1026, *July*, 1929.

On the formation of a lead peroxide plate in sulphuric acid the lead sulphate which is first formed is held to the lead plate by cataphoresis in addition to a possible adsorption, and is, therefore, in a position to be oxidised to lead peroxide. Lead sulphate on the surface of lead changes with time so that the anode effect of cataphoresis in sulphuric acid solution becomes negligible relatively to other factors. Cataphoresis plays a part in the electrolytic determination of lead. Lead ions cannot be carried to the anode, nor is there evidence of the existence of any appreciable amount of lead as part of a complex anion. Consequently the only lead ions that can be oxidised to plumbic lead are those which happen to be at any moment in contact with the anode. After the plumbic ions have been oxidised cataphoresis carries the negatively charged lead peroxide against the anode. J. J. S.

417. Electrophoresis and Electroendosmosis. A. Boutaric. *R.G.E.* 26. *pp.* 93–103, *July* 20, 1929.

The general phenomena of electrophoresis and of electroendosmosis are described and discussed. The practical bearing of the phenomena is pointed out, and the industrial applications are indicated. The fundamental theories, and the laws governing the movement of the particles of solid matter suspended in the liquid, or of the liquid itself are given. The author reviews the chief applications of the various changes indicated. F. J. B.

418. Electrolytic Polarisation as a Cause of Inhibition of Crystal Growth. H. Brandes. *Zeits. f. phys. Chem.* 142. *Abt. A.* 2. *pp.* 97–112, *June*, 1929.

From the literature [see Abstracts 1341, 1841 (1922), and 1738 (1929)] it appears that the growth of a crystalline phase is in two stages: rapid addition of new material and restrained arrangement in the crystal lattice. The present investigation concerns the particular case of electrolytic crystal growth and the attendant polarisation phenomena. With depolarisation free electrodes (polished platinum foil in metallic salt solutions) the potential change is directly proportional to the quantity of electricity, and such an electrode behaves as an ideal condenser. This behaviour is explained on the assumption that the ions provided by the current are embedded in the Helmholtz double layer and their charge added to the capacity of the electrode condenser. With depolarised electrodes, as in the case of crystal growth, the ions are discharged prior to entry into the lattice and the depolarisation is proportional to the polarisation voltage. The proportionality constant with respect to the velocity of crystal growth (depolarisation) and polarisation voltage is exceedingly sensitive to temperature change. H. H. Ho.

419. Current Density-Potential Curves over the Region of Residual Currents. E. Liebreich and W. Wiederholt. *Zeits. f. Elektrochem.* 35. *pp.* 367–368, *June*, 1929.

The shape of the current density-potential curves depends upon the position of the ammeter; whether it is in the main circuit or in a circuit including the experimental cell. The differences obtained are illustrated with results given by a silver kathode in 0·02*N*-sulphuric acid against platinum. The effect of oxidising agents on the residual current is similar to that observed by Muller and Konopicky with oxygen. F. J. W.

420. Potential Differences across the Boundaries between Solutions of Mixed Univalent Chlorides. E. R. Smith. *Bureau of Standards, J. of Research,* 2. *pp.* 1137–1143, *June,* 1929.

Potential differences across the boundaries between solutions of mixed univalent chlorides were measured, using a flowing junction and silver-silver chloride electrodes. There is no evidence of complex formation, and the constant ion conductance principle which MacInnes has shown to be valid in solutions of pure univalent chlorides is probably equally valid in their mixtures. AUTHOR.

421. Potential Difference between Two Phases and Individual Activities of Ions. E. A. Guggenheim. *J. Phys. Chem.* 33. *pp.* 842–849, *June,* 1929.

It has been recently shown by Taylor [see Abstract 771 (1928)] that the e.m.f. of the cell with transference is thus a function of molecular free energies solely and is not a function of ionic free energies. It, therefore, can yield no information concerning ionic free energies, and with the possible exception of single electrode potentials and rates of reaction there appears to be no occasion for the use of ionic free energies as experimental quantities, but only as a mathematical device. It is shown that Taylor's first conclusion may be considered as a corollary to a more general principle, from which it also follows that to his second conclusion there are no possible exceptions. E. E. F. d'A.

422. Luminescence Phenomenon in Electrolysis with Mercury Electrodes. A. Dumanski, Z. Česchewa and A. Banow. *Zeits. f. phys. Chem.* 3. *Abt. B.* 6. *pp.* 440–442, *June,* 1929.

A glass vessel contains mercury above which is an aqueous electrolyte. On passing an electric current through the electrolyte from the mercury to a platinum kathode suspended in the electrolyte, a luminescence is observed at the surface of the mercury. The luminescence, which is not accompanied by any rise in temperature of the liquid, gradually diminishes as a film of insoluble reaction product forms on the surface of the mercury. On breaking the film by shaking the light reappears. The effect is observed with a p.d. across the cell of 12 to 70 volts, and a current density at the mercury surface of 0·004 to 0·08 ampere per sq. cm., being stronger at the higher voltages and current densities. The phenomenon only occurs with such electrolytes as give rise to insoluble compounds, and the intensity and duration vary with the concentration of the solution. Spectrographic observations on the nature of the light are recorded. An aluminium or mercury kathode may be substituted for the platinum, with the same results. A. J. M.

423. Anodic Nickel (Cobalt) Triacetate and Kolbe's Reaction. C. Schall and C. Thieme-Wiedtmarckter. *Zeits. f. Elektrochem.* 35. *pp.* 337–344, *June,* 1929.

The yield of nickel (cobalt) triacetate depends upon the temperature at the anode, and upon the quality of the acetic acid. The presence of water in the acetic acid has a great influence on the efficiency of the process. Solutions of nickel (cobalt) diacetate in acetic acid, which had been dried by boron triacetate, showed no maxima or minima of equivalent conductivity. The maxima and minima appeared when water was added. Trimolecular nickel (cobalt) triacetate was formed at the anode when the triacetate solution was electrolysed. Ni(Co)–triacetate was prepared by chemical means. Ozone dried by P_2O_5 was passed into a cold saturated solution in dry glacial acetic acid, and the complex salt separated by crystallisation. The synthesis of hydrocarbons by the electrolysis of salts of the fatty acids was shown to be influenced by the presence of water.

F. J. B.

424. Anode Reactions of Fluorine. N. C. Jones. *J. Phys. Chem.* 33. *pp.* 801–824, *June*, 1929.

Fluorine being the most electronegative of the elements with a probable electrode potential of 2·85 volts, it should be possible by its means to reproduce any electrochemical anode process. This is shown to be the case as regards a number of reactions—the action of fluorine on sulphates and sulphuric acid, phosphoric acid, carbonates, borates, potassium hydroxide, cobaltous, manganous, chromic and plumbous salts, and on a solution of potassium acetate—the mechanism of which is discussed in detail on the assumption that that reaction takes place which does so at the lowest voltage, *i.e.*, with the least expenditure of energy. The conclusions arrived at differ substantially in some cases from those of previous investigators (in particular Fichter and his collaborators). The author's views are confirmed by experiments in connection with all but the first four of the above-noted reactions. A detailed account of the preparation of fluorine by electrolysis of potassium hydrogen fluoride in a slightly modified Mathers' magnesium cell is given.

C. A. S.

425. General Dilution Law and Mechanism of Electrolytic Dissociation. W. Tretjakov. *Zeits. f. Elektrochem.* 35. *pp.* 440–451, *July*, 1929.

Ostwald's dilution equation is applicable only when the concentration of the ionic atmosphere of the solution is low and hence the number of associated ions small, that is, to weak electrolytes. A relationship is now deduced between the degree of dissociation according to the conductivity and the number of free, unassociated ions in the solution. This relationship is expressed by the formula $\mathrm{F} = a \Big/ \sqrt{1 + \frac{n\mathrm{D}}{v_1} a^{3m/2n}}$, where F is the amount of free ions, a the degree of dissociation (determined conductimetrically), D the dielectric constant of the solvent, v_1 the volume of the pure solvent, m the number of ions into which the electrolyte decomposes, and n its valency. Insertion of this value of F in Ostwald's equation, $\mathrm{F}^2/(1 - \mathrm{F})v =$ constant, where v is the volume of the solution, gives an expression which agrees well with the experimental data for a number of aqueous solutions of salts and acids. The values obtained for K are regarded as more concordant than those given by Ostwald's or Rudolphi's equation, the deviations with concentrated solutions being regarded as due to solvation of the ions. If the association factor or the ratio of the velocity of the associated ions to that of the free ions is denoted by e and the true degree of dissociation by S, $a = \mathrm{F} + e\mathrm{A}$ and $\mathrm{S} = \mathrm{F} + \mathrm{A}$. Utilisation of these equations leads to a relationship more general than that given above. Calculation of the values of e from the conductivity data for a number of electrolytes shows that the expression $e = n\mathrm{KD}/2$ holds approximately.

T. H. P.

426. Interionic Forces and the Ionisation of Weak Electrolytes. H. M. Dawson. *Leeds Philosoph. and Lit Soc., Proc.* 1. *pp.* 491–496, *July*, 1929.

Considers the interionic forces in salt-free acid solutions, from the point of view of the degree of ionisation in pure aqueous solution as determined by the conductivity method; also considers the relation between the reaction velocities and the concentration, and concludes that there is substantial evidence that the interionic forces in such solutions are very small compared with those required by the Debye-Hückel theory and Lewis and Randall's ionic strength hypothesis. Experiments have been made in which inert salts were added to the acid solutions. These affect the catalytic activity, and so the ionisation constant changes. The results obtained are compared with those calculated by the Debye-Hückel theory, and it appears that the interionic forces in solutions of low ionic strength are much smaller than the theoretical ones, and that the ionic strength hypothesis is not applicable when hydrogen ions are involved in the electrical field effect. H. N. A.

427. Concentration Changes in Dilute Amalgams of Alkali and Alkaline Earth Metals during the Passage of an Electric Current. M. le Blanc and R. Jäckh. *Zeits. f. Elektrochem.* 35. *pp.* 395–409, *July*, 1929.

When amalgams of the alkali and alkaline earth metals conduct an electric current, changes of concentration are found to take place. In a sodium amalgam, the sodium concentration at the anode increased during electrolysis. The relative effect, that is the difference of concentration at the two electrodes divided by the current density, showed a slow decrease with rising temperature, in the interval 25° to 75° C. The relative effect tended to a limiting value after about 2000 hours. The relative effect was found to be proportional to the original concentration. Barium was found to concentrate at the anode from dilute amalgams, and lithium and potassium increased in concentration at the kathode. Evidence was put forward to show that these changes of concentration were not caused by thermoelectric phenomena. F. J. B.

428. Precipitation of Manganese Dioxide by Electrolysis with Alternating Current. A. P. Rollet. *Comptes Rendus*, 189. *pp.* 34–35, *July* 1, 1929.

A complete precipitation of manganese was obtained on electrolysing by an alternating current a solution of a nickel salt containing a small quantity of manganese. After a time of electrolysis a brown colour appears round the electrodes, and then a deposit forms on the bottom of the trough, which consists of manganese dioxide. Sometimes at the beginning of its formation a thin brown layer of binoxide covers the electrodes. The precipitation occurs whatever the acid radicle of the salt, but the presence of nickel appears to be absolutely necessary. The manganese must be present only in small quantity. J. J. S.